The Reclamation Era

February 1954

IN THIS ISSUE:

Sugar Beets Have a New Role

Commissioner's Offices Reorganized

Official Publication of the Bureau of Reclamation

The Reclamation Era

FEBRUARY 1954 Volume 40, No. 1

IN THIS ISSUE . . .

snow surveyor and snowmobile.

DESIGN AND ILLUSTRATIONS by Graphics Section
Bureau of Reclamation, Washington, D. C.

J. J. McCARTHY, Acting Editor

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Special Notice to All Subscribers

Beginning with the July 1953 issue, the Reclamation Era became a quarterly publication. This is just a reminder in case you missed the special notice in our last two issues.

Subscription rates for the quarterly publication are 50 cents per year, with 15 cents additional required for foreign mailing. Separate copies may be purchased for 15 cents each. Under the new policy all subscriptions should be sent direct to the Superintendent of Documents, Government Printing Office, Washington 25, D. C. Requests for changes in mailing address, renewals, and cancellations should also be sent direct to that agency.

Subscriptions in force at the time of the change in the publication schedule were extended for a maximum period of two years from last July. If, at the expiration of that time, subscribers have not received all copies due them under the previous subscription rate, a refund will be made by the Superintendent of Documents.

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THE NEXT QUARTERLY ISSUE of the ERA, due in May, will carry our annual spring feature, namely, WEST-WIDE WATER FORECAST.

Pushbutton Flood Control

California's unpredictable rivers, already partially harnessed and put to work by the great dams of the Central Valley project, have been brought under further discipline of "pushbutton" control from a central operations point. Installation is now complete on a farflung system of six radio reporting precipitation stations that spot at a glance conditions of rain and snow on the 4,500 square mile area draining into Sacramento River between Shasta Dam and Chico Landing.

The core of the system, which literally reports a picture of watershed conditions for Central Valley project operations headquarters, is a newly developed electronic device. With a series of these amazing gadgets, CVP operation forces can tell almost instantaneously when and where potentially flood producing rain has fallen and what the streamflow might be.

Because of the rapidity of flood flows in the Sacramento River drainage basin's stream channels, it was necessary to install a so-called "on-call" system governing the remote stations. Each station is equipped with a receiver continuously awaiting an order.

Upon receiving a given frequency modulated tone signal from the control transmitter, any one of the radio transmitting rain gages will report the rain and snow it has accumulated up to the instant it was ordered to report.

"With this instant coverage we will be able to forecast flood peaks as much as 12 hours in advance on Sacramento River tributaries, and to regulate water releases from Shasta and Keswick Dams, accordingly," Regional Director Clyde H. Spencer said. "The radio reporting system is helping greatly in the present flood control functions of Shasta Dam."

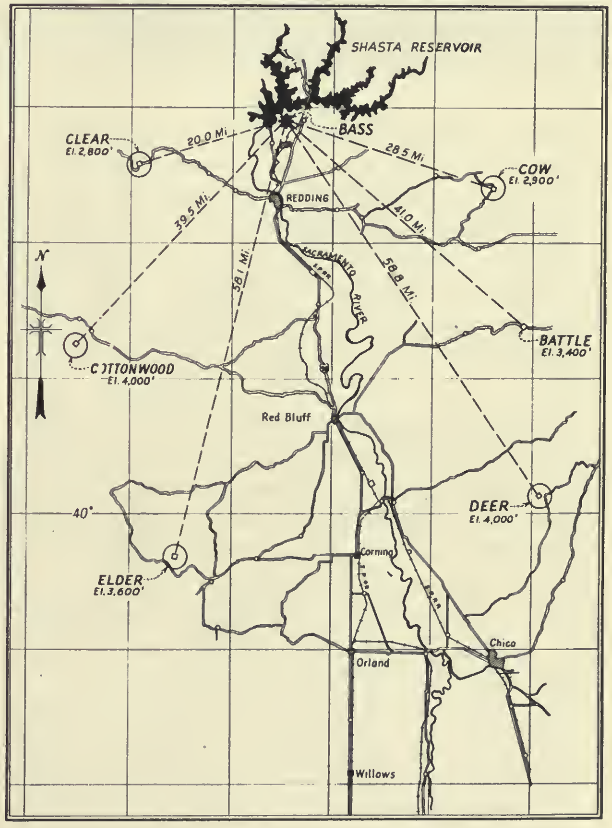
Eventually the watershed control system will be installed on other rivers, including the American, following completion of Folsom Dam. It also can be expanded to control CVP canal operations from a central point.

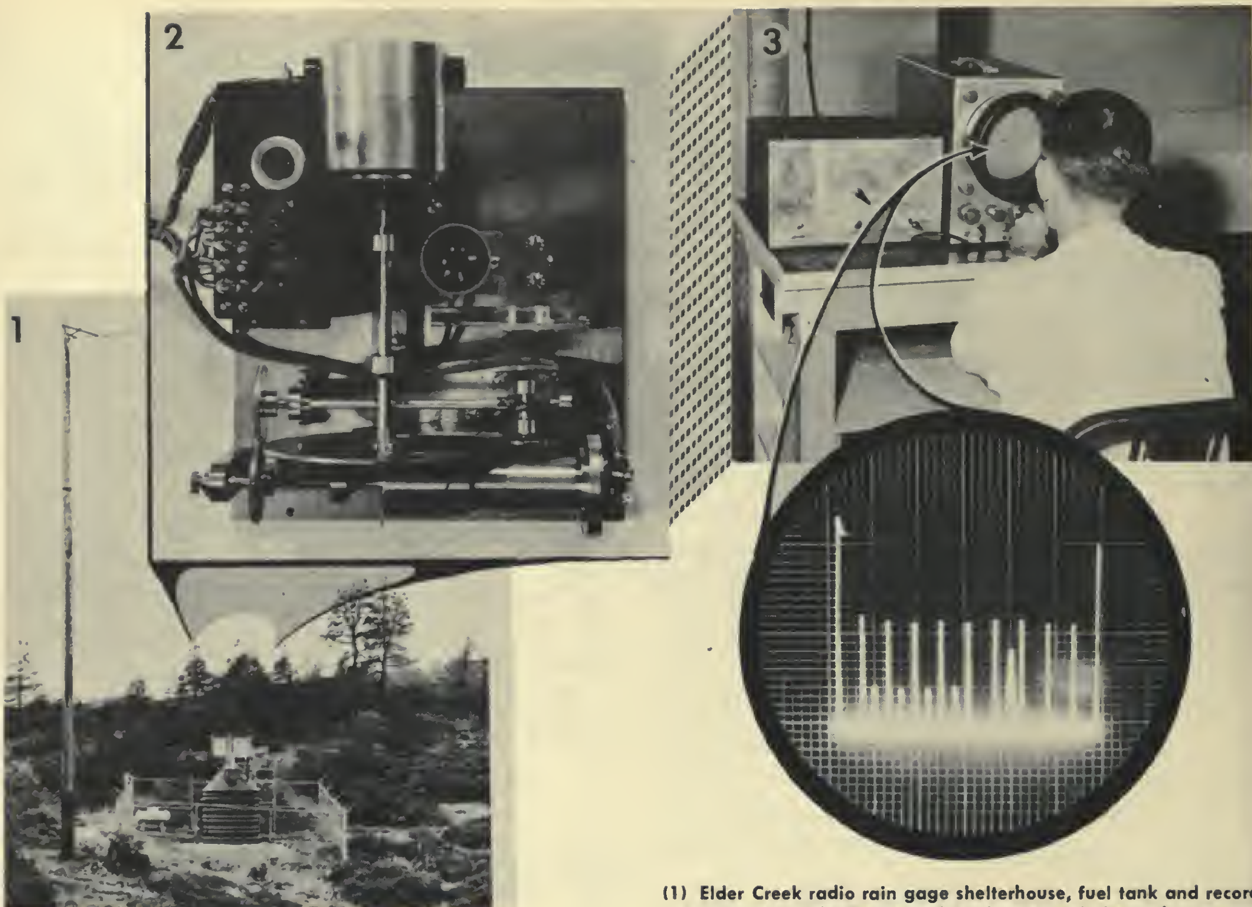
The Bureau of Reclamation is using the new radio reporting system in coordination with existing measuring, reporting, and forecasting systems of the United States Weather Bureau, the State of California, and the United States Army Corps of Engineers. These agencies already have a large system of rain and streamflow gages. Some are merely recording devices. Others have to be located near roads and power facilities, limiting their usefulness. Still others are reporting systems, transmitting information over leased telephone circuits, and by radio.

The new radio reporting rain gages, developed by the Denver, Colo., Reclamation laboratories at the request of Martin H. Blote, Operation and Maintenance Superintendent, can operate unattended for weeks at a time in remote mountainous locations. The readings are projected on a screen in Keswick powerplant whence they are transmitted by teletype to the Water Control Section at Sacramento. Here the readings are converted into flood flows by means of unit-hydrographs and flood-routing methods.

Key to the new system is a small photoelectric coding device. This portion of the system was

LOCATION MAP of RADIO RAIN GAGES





(1) Elder Creek radio rain gage shelterhouse, fuel tank and recording gage inside the fenced enclosure and the radio antenna outside. (2) The electronic coding device. (3) The monitoring station consisting of radio transmitter and receiver, station selector, and the oscilloscope.

developed by C. R. Daum and R. H. Kuemmich of the Buréau's Engineering Laboratories in Denver, and W. U. Garstka of the Hydrology Branch.

The initial installation of six radio reporting rain and snow gages is primarily for flood control, one of the several functions of Shasta Dam, which is the key unit of the Central Valley project.

Regional Director Spencer explained how it works:

"The varying weight of water in the rain catchment tank is indicated by the photoelectric coding apparatus. Radio impulses are received and projected in graph form on an oscilloscope screen which looks like a small table television set. As an example of how the system will work, let us assume that a large flow of water is being released from Shasta Dam to evacuate flood-control space in the reservoir."

"Let us assume that, upon order, the rain gage transmitters on the east side of the valley flash reports on the screen of the central receiver showing torrential rains covering the entire east side area. Within a matter of minutes the Water Control Section determines the potential flood peaks on east side streams, and calculates the time the resulting flow will reach the Sacramento River. Water releases at Shasta Dam can then be regulated to provide channel space for the oncoming uncontrolled, flood flows."

The use of this "on-call" system helps Reclamation in maintaining its flood control goals between Shasta Dam and Chico Landing. These goals include the restriction of maximum flows in the Sacramento River of 80,000 cubic feet per second at Redding, 100,000 second-feet at Red Bluff, and 130,000 second-feet at Chico Landing.

The remote radio reporting precipitation stations are located at strategic points in the 4,500 square mile drainage area, near the headwaters of

SHASTA DAM river outlet valves discharging to evacuate flood control storage space in Shasta Lake. *Photo by H. Colby.*

Cow, Battle, and Deer Creeks on the east side of the valley, and on Clear, Cottonwood, and Elder Creeks on the west side. To provide typical coverage of the area, it was necessary to locate them in wild, remote places. The one exception is the Battle Creek station, not far from State Highway 36.

From these remote stations, radio impulses are beamed to a relay station on Bass Mountain, north of Redding and near Shasta Dam. The information is then relayed to the receiver in the control room of Keswick powerplant. Radio transmission distances vary from 20 to 60 miles. To make contact with any of the transmitters, the operator at Keswick powerplant has only to turn a selector switch, press a contact key, and then read the reply in the form of an image flashed on the screen. Readings are regularly teletyped to the Central Valley project operations office at Sacramento.

Reclamation engineers had to make provisions against hazards of nature, such as subfreezing weather, for the continuous operation of the transmitters. These radio reporting rain and snow gages are provided with a heated precipitation gage intake tube developed specifically for this network by Frank C. Allen, Robert E. Glover, and Walter U. Garstka of the Bureau's offices in Denver, and Howard M. Posz of the Operation and Maintenance Division, Sacramento. The first heated precipitation gage intake tube was built and tested by Reclamation's engineering laboratories in Denver. Small metal shelter houses with controlled heating protect the mechanical and electronic equipment. Antifreeze solution is used in the gages. # # #

YOUR MAGAZINE

Are there particular types of articles which you would like to see in the Era that we have not printed to date? If so, please let us know, and we shall do our best to comply with your wishes.

CAN YOU "BEET" IT?
Redfield Development Farm yielded 30 tons of beets an acre.

SUGAR BEETS HAVE A

by

P. B. SMITH
General Agriculturist
The Great Western Sugar Company
President
The Beet Sugar Development Foundation

A miracle has been taking place in the methods employed in the production of sugar beets in the western United States. For more than half a century, the sugar beet has proved to be one of the most dependable crops to be grown extensively on western irrigated land. Up until about 10 years ago, sugar beets was known as a crop that required a great amount of hard labor to do the thinning, the hoeing, and the harvesting. Developments that have taken place chiefly in the last 10 years toward mechanizing the crop have changed all this.

There is no section of this country in which the beet crop is grown as successfully as it is in western irrigated areas. Roughly, 550,000 acres, or about two-thirds of the total national beet production today, is centered in the great irrigated plateau of the western United States. High returns from sugar beets are an old story on every reclamation project where sugar factories are available. In one recent year, for example, sugar beets grown on only 14 percent of the land in seven Montana reclamation projects actually accounted for 40 percent of the total crop value of all crops grown on those projects. The growing of sugar beets in these areas permits the development of a combination agricultural and manufacturing industry resulting in a very desirable economy.

There are four apparent reasons why farmers are focusing their attention on growing sugar beets now. First, price incentives which stimulated the production of some crops the past 10 or 12 years have changed to the point where growers are looking to crops that might produce greater returns. Second, the increased use of machines and new methods in growing sugar beets makes it possible for farmers to grow sugar beets cheaper and easier than ever before. For example, a United States Department of Agriculture survey conducted in 1925 found that it took 10 man-hours to grow a ton of sugar beets. A recent estimate, based on the reduction of the labor requirements now achieved, indicates that this year it will probably take less than 4 man-hours to grow a ton of sugar beets in our western irrigated areas. Third, farmers can now expect much higher yields than a few years ago through the use of new sugar beet varieties and the employment of better fertilizer practice. Fourth, the ability of the sugar beet to

furnish high energy human food, as well as badly needed feed for livestock is another definite reason for the sugar beet coming back into the cropping system on western farms.

Mechanical harvesting of beets was the most urgent thing that initially took the attention of investors and implement manufacturers. An idea of the speed in which the machine harvest has taken over in the United States is gained by the knowledge that less than 3 percent of the acreage was so harvested in 1944, while between 85 and 90 percent was handled by mechanical methods in the fall of 1953. The average beet harvester is a one-row machine that averages about 40 acres during the harvest season. On the basis of a Colorado A & M College survey, about 43 percent of the labor is saved as compared with hand harvest.

The planting of segmented beet seed which was started about 1942, and through the use of better drilling equipment, farmers are able to secure a more uniform pattern of seedlings without so much bunching of plants. Four of five years ago, small knife thinning machines were first available to growers, and since that time machine thinning has become very popular. A further development of the thinning machine technique has now completely eliminated the necessity for hand or finger thinning, and it is only necessary for the workers to hoe out weeds. This reduces the labor requirement by over 50 percent, as compared with the hand thinning of segmented seed. The use of the machine enables the farmer to get his beets thinned promptly without a loss, as was quite often the case with hand thinning. In fact, the yields, because of improved stands, and better cultivation in the row, are increased. Employment of the thinning machines greatly reduces costs, and at the same time improves the income of the laborers who are used for hoeing out weeds.

NEW ROLE

A great deal of research work has gone into the development of chemical weed sprays, particularly the grass-type weeds. A chemical known as IPC, sprayed on the soil at the rate of 3 pounds per acre and disked in thoroughly ahead of planting, has been very successful in controlling wild oats and

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(1) THINNING MACHINES have made possible a completely new type of sugar beet production which is tailormade for irrigated areas. (2) Irrigation siphon tubes have greatly benefited sugar beet growers in making better use of water. Frequent light irrigations gets best yields. (3) Typical one-row beet harvester is now a common sight on most beet farms. No other crop in the West has so rapidly achieved complete mechanical harvest as has sugar beets. *Photos courtesy of the Author.*

This fine group of cattle adjacent to a sugar beet factory at Greely, Colo., thrive off beet by-product rations at a far less cost than other available rations. *Photo courtesy of the Author.*

volunteer grain in beet fields. The use of 5 to 8 pounds of TCA, sprayed on the soil after the crop is planted, has been instrumental in controlling the small grasses such as foxtail. Some new chemicals are being tested that are selective in their effect, killing most of the broad leaf weeds as well as grass without injury to the beets.

For a great many years, plant breeders have been working tirelessly on development of new strains of beets better adapted to conditions in the western United States. Such varieties now offer resistance to Curly Top, leaf spot, many root rot diseases, and at the same time show improvement in sugar and yield. These geneticists are also now busy transferring these varieties into single germ seed strains so that fuller use of complete mechanization may be available to growers in a few years. Better fungicides for protecting the young seedlings, and insecticides placed on the seed for protection against wireworms, root maggots and flea beetle larvae, are already a reality, and contribute greatly to more uniform stands for mechanical thinning.

Benefits from these advances in production flow in all directions. Individual growers benefit directly from the reduced labor costs and the possibility of securing better workers because fewer are needed. At the same time, growers who are feeding livestock are looking to the beet byproducts for cheaper livestock gains. The average acre of sugar beets grown in the United States in 1953 provided in the byproducts, such as beet tops and dried molasses beet pulp, feed nutrients equivalent to about 65 bushels of shelled corn. When one realizes that the average corn yield in the State of Iowa in the same year was 56 bushels per acre, one is impressed by the true value of the sugar beet as offering 2 crops in 1. There is little wonder that there is an increased emphasis on western reclamation projects in raising sugar beets. # # #

IRRIGATION DEVELOPMENT AND PUBLIC WATER POLICY

by ROY E. HUFFMAN

The Ronald Press Company, New York, N. Y.

The above titled volume is a new book containing a comprehensive study of the economic and social aspects of irrigated agriculture and public water policy in the United States. It reviews past experience in the development of irrigation and how that experience has become institutionalized in our economic and legal structure. It investigates the various problems in planning, organization, financing, and operation of projects and individual units as well as in the overall economic evaluation of water resource programs with their multiple uses.

It discusses fully the important considerations that are essential to sound and farsighted irrigation policy on the local, regional and national levels and assesses the role of irrigation in river basin development and the Nation's agricultural production.

Mr. Huffman, the author, was formerly with the Great Plains Water Conservation and Utilization Program of the United States Department of Agriculture. He now teaches agricultural economics at Montana State College. Mr. Huffman has kept in close contact with current practical problems in the field, as a member of the Missouri Basin Regional Research Committee, the Western Water Resources Committee, and as a Consultant to the Missouri Basin Survey Commission. He is also the author of numerous articles, research studies, and reports which have appeared in leading journals in his field. #

L. N. McClellan

S. W. Crosthwait

Grant Bloodgood

Clyde H. Spencer

Floyd E. Dominy

N. B. Bennett

COMMISSIONER'S OFFICES REORGANIZED

Commissioner W. A. Dexheimer, on December 1, announced the reorganization of Reclamation headquarters in Washington, D. C., and Denver, Colo., and additional appointments.

At the same time, the Commissioner stated that regional and project offices would be retained in their present locations to continue to provide service to water users at the grassroots level.

The new appointments are as follows: Assistant Commissioner and Chief Engineer, L. N. McClellan; Assistant Commissioner for Administration, S. W. Crosthwait; Associate Chief Engineer, Grant Bloodgood.

In the reorganization, Assistant Commissioner Harvey F. McPhail was designated Assistant Commissioner for Irrigation and Power.

Another major change in the Bureau organization affected the California projects office. It was reactivated as region 2 with Supervising Engineer Clyde H. Spencer being appointed the new Regional Director.

Chiefs of the newly created divisions in the Washington Office are as follows: N. B. Bennett, Project Development; Floyd E. Dominy, Irrigation; Henry B. Taliaferro, Power; T. W. Mermel, General Engineering; Alfred R. Golzé, Program Coordination and Finance; Glenn D. Thompson, Personnel; J. C. Thrailkill (Acting), Procurement and Property Management; Luther E. Cliffe (Acting), Foreign Activities; L. Ray Awtrey (Acting), Organization and Methods; Harold L. Byrd (Acting), General Services.

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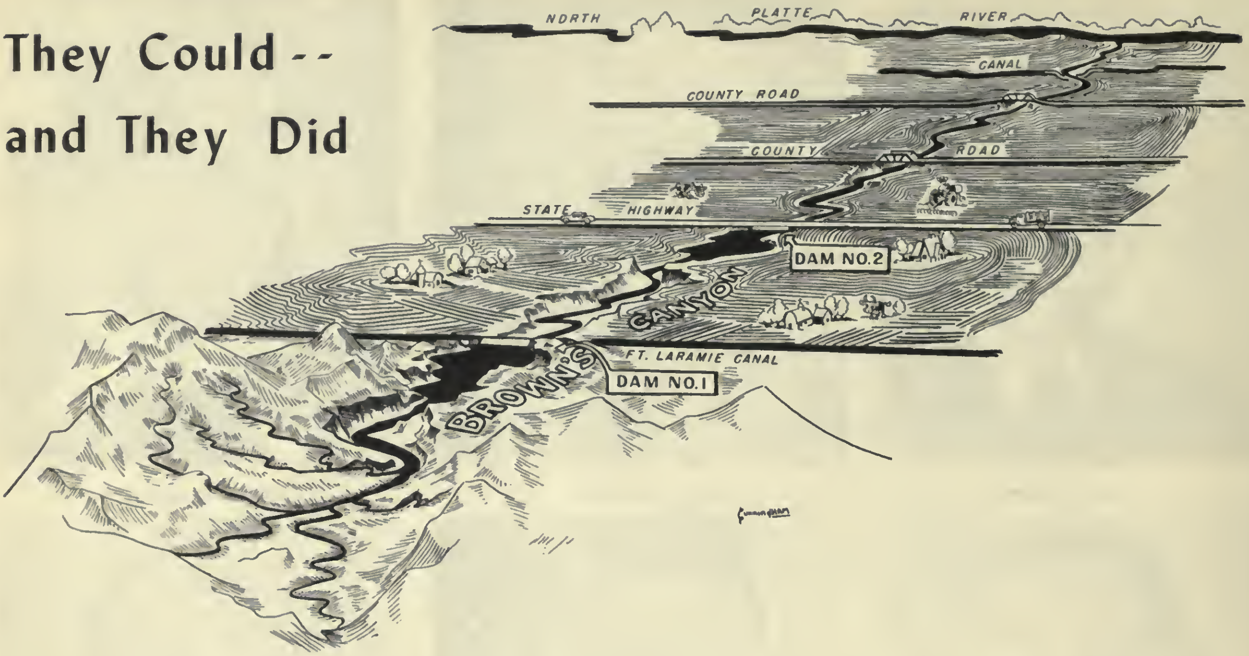
They Could -- and They Did



by WESLEY LUNDGREEN, Engineer
Bureau of Reclamation
Torrington, Wyoming

Farmers in the Mitchell Valley of western Nebraska have applied that old admonition, "Walk, Don't Run to the Nearest Exit," to a problem which was costing them and their State and county governments thousands of dollars year after year.

Their problem was what to do about natural watershed drains which were periodically running wild under the pelting of heavy rains, causing a loss of a fluid mass of rich soil and water which battered its way to the North Platte River. These surging floods crumpled bridges, tore out irrigation structures, uprooted or buried crops, gouged out new channels and left heartbreaking devastation in their wake.

Especially was the Brown's Canyon drain out of control. The farmers who lived in the general area of Brown's Canyon, which drains a 15-square-mile watershed in Scotts Bluff County, Nebr., surveyed the problem with dismay and thoughtfulness. They recalled how they and their fathers had struggled in the conquest of this land which had once been desolate prairie, how they had made the land produce abundant crops under irrigation. They recalled the long labor and then they saw the rampaging flash floods threatening to wash all that hard work away.

They wondered how they could make those flood flows walk, not run, to the river; and they decided that Brown's Canyon should be their guinea pig, their first objective in licking this problem.

The matter was put before everyone concerned. The farmers, their irrigation districts and flood control associations, and interested Federal, State, and local agencies got together in meetings to look for possible solutions. It was apparent that what was happening in Brown's Canyon was also true on other watersheds whose flow ran off the dry lands and across the irrigated farms of the North Platte Valley. Confronted with the problem, the group acted. The people in Brown's Canyon were ready when their watershed was selected as the first one upon which an attempt would be made to install a small but comprehensive flood control program.

Next, a plan was needed that would blueprint the work to be done. The resources of Federal and State agencies were made available to work out the plan. In Brown's Canyon, irrigation structures worth $110,000 had been built by the Bureau of Reclamation. These structures were continually damaged by the storms. To protect this investment at the least possible cost, Reclamation agreed to finance the required surveys. The Soil Conservation Service, Region 5, agreed to make the survey and prepare a plan. The First Commissioner Soil Conservation District agreed to organize the individual farmers and groups interested in the program in such a manner that they

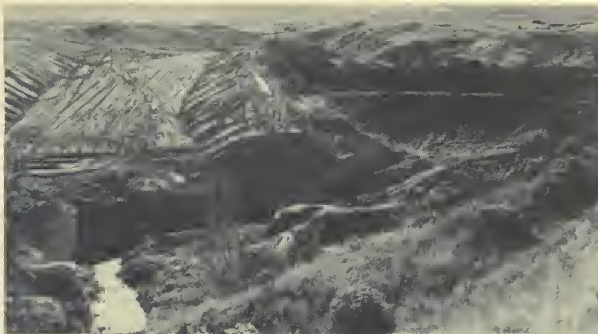
could make collections for financing construction of needed works. The Nebraska Department of Roads and Irrigation agreed to provide their available technical data concerning the watershed, roads, and waterways and to furnish other information. These four parties executed a memorandum of agreement spelling out in detail what was to be done and who was going to do it.

In July 1952, the Soil Conservation Service began work on the survey, using 17 technicians. In approximately a month they came up with a plan for controlling the floods. In September 1952, the plan was presented to the local farmers, the local irrigation districts, county commissioners, State highway department, and other interested groups. The plan was reviewed and discussed. Minor changes were made to meet the approval of the local groups.

The recommended treatment provided for in the plan would reduce flood peaks of many of the storms, particularly those occurring annually. In addition, soil erosion and sedimentation damage would be reduced and soil productivity would be maintained. The plan includes two flood water detention dams, drop structures, lining of reaches of the Fort Laramie Canal, replacing culverts with larger capacity bridges, raising timber bridges, replacing and enlarging underdrains and the installation of on-farm conservation practices. These works would stabilize portions of the channels and banks, reduce structural damages and reduce the flood water and sediment damages. The estimated cost for installing flood control works in the main channel of Brown's Canyon amounted to $101,775.

With a plan that everyone agreed upon before them, the next job tackled by the local people was to raise the money to finance construction. The farmers and their cooperating Federal, State, and county groups again met. They decided that they could finance the program without establishing a formal organization. They would work informally with the spirited and guiding leadership of Harold Ledingham and other members of the First Commissioner Soil Conservation District Board. This Board, working closely with Joe Styskal of the Soil Conservation Service and myself as the Reclamation Bureau representative, set their goals.

Between November 1952 and April 1953, the cash was on the barrelhead. Eight local farmers got together and put up $11,750. The Gering-Fort Laramie irrigation district contributed $21,700. Scotts Bluff County gave $10,000. Mitchell irrigation district donated $3,000. The Nebraska Department of Roads and Irrigation pledged $31,000, and the Bureau of Reclamation made $29,500 available—a total of $106,950. Each of these contributions was made for financing features of the plan of most concern to the donor. In addition, all of the easements for the two dams, reservoir areas and borrow areas were provided by the local farmers without cost to the constructing group * * * even though, in some cases, these farmers derived no direct benefits.



Dam No. 1 (top photo), under construction by Bureau of Reclamation, is nearing completion. New county bridge crossing on Lyman-Mitchell highway (above photo). ***Both photos courtesy of the Author.***

Since April 1953, excellent progress has been made in constructing the major features of the flood control plan. Dam No. 1, which will hold approximately 300 acre-feet of water and is 62 feet high and 260 feet long, has been under construction by the Bureau of Reclamation and is nearing completion. Dam No. 2, which will hold approximately 185 acre-feet of water and is 760 feet long and 45 feet high, is now under construction by the Nebraska Department of Roads and Irrigation. An underdrain on the Mitchell Canal is under construction with good progress being made. The Gering-Fort Laramie Irrigation Dis-

trict is handling the construction of this feature. A tube and culvert on the Lyman-Mitchell road has been replaced by the Scotts Bluff County and the Nebraska Department of Roads and Irrigation. A bridge in the canyon has been raised 5 feet to provide adequate capacity through Brown's Canyon Drain. The Gering-Fort Laramie Irrigation District has made several channel improvements by enlarging the channel and riprapping bad curves. They are also replacing water crossings with steel siphons and they are now completing the installation of about 500 feet of canal lining on either side of the Fort Laramie canal siphon on Brown's Canyon. Only two major features, which were recommended in the plan, remain to be built. These are scheduled to be completed by the spring of 1954.

On-farm conservation practices have been recommended to the individual farmers, and several definite programs are being prepared by the Soil Conservation Service. A local committee is to be organized soon to follow through on recommended farm practices. A series of meetings is being organized to inform residents on conservation practices in the watershed.

They could, and they did control the floods on Brown's Canyon. The local people did it with strong leadership of the First Commissioner Soil Conservation District Board of Supervisors and with the cooperative assistance of Federal, State, and county groups. What they did in Brown's Canyon aptly demonstrates what is possible when the local farmers combine their resources with Federal, State, and local agencies to tackle a difficult job. The ball is rolling and leaders, like M. O. Andrews of the North Platte Valley Flood Control Association, are seeing to it that similar jobs will follow. # # #

Discharge Curves Available

In the October 1953 issue of the Reclamation Era we published an article entitled "How to Build an Inexpensive Measuring Flume." When we were making up our galley proofs, space limitations prevented us from including the discharge curves necessary to calculate the flow.

As a result, we have received numerous inquiries about and requests for these discharge curves. To accommodate our readers we have had a number of copies processed, which may be had free, upon request.—Ed.

Green Manure Pays Off

by

LLOYD E. CAVASOS, Associate County Extension Agent, Quay County, N. Mex.

What does it take to make new land produce? Tucumcari irrigation project farmers have been asking this question since the first land was put into production in 1946 following the completion of the first district unit. They are finding the answer with green manure crops which furnish the cheapest and most successful means of "building up" the fertility and increasing production.

This fact was well illustrated on the Earl W. Curtis farm near Tucumcari. In 1949 Mr. Curtis cleared, deep plowed, and disked a 20 acre plot. On 18 acres he sowed alfalfa and on the remaining 2 acres he planted beans. The 2 acre plot produced beans again in 1950, and in 1951 it was used as a home garden. Last year the alfalfa was turned under and all 20 acres planted to a mixture of Atlas sorgo and Red top cane for silage. The field was irrigated in May, planted in the latter part of June and irrigated for the second and last time in September. No fertilizer was applied and the full 20 acres received the same cultural treatment.

Throughout the season, a striking difference could be seen between the 2-acre plot and the 18-acre plot. In September the sorghum was just booting out and the portion where alfalfa was turned under as green manure was approximately 8 feet tall, while the rest ranged from 2 to 4 feet in height. The 18 acres yielded 20 tons of silage per acre, while the 2 acres yielded 5 tons per acre.

The explanation for Curtis' success does not seem too difficult. Green manure increases the yield of subsequent crops and improves the friability of the soil. This is brought about by an increase in the organic matter, prevention of leaching of plant nutrients, and an increase in the supply of nitrogen in the soil.

Another successful soil-building program on the Tucumcari project was initiated by Henry Batterman. He built his farm into one of the most advanced farming enterprises on the proj-

At left, Henry Batterman plowing under sweet clover on his irrigated farm. Above photo, Gordon Hoff, Extension Agronomist (left), and L. G. Miller, Quay Co. Seed Growers Association, and owner Earl W. Curtis compare effects of green manure on Curtis' forage sorghum. *Photos by the Author.*

ect through hard work, good crop and soil management, rotations, and the proper utilization of green manure crops and commercial fertilizers. Batterman proved the value of building up his soil last year by harvesting 9 tons of hay per acre from 10 acres of first year alfalfa. This farm was recently purchased by A. G. Grooms who continues to follow a strict rotation system, just as Batterman did, and part of that system is plowing under full grown crops of alfalfa and sweet clover.

During 1953 a large number of farmers realized the value of green manuring just as Curtis, Batterman, and others had earlier. As more and more of the 8,000 acres of alfalfa are plowed under, the crop yields rise proportionately. The soil which has grown alfalfa, vetch, and other green manure crops is easier to irrigate, and blowing is reduced.

According to historians, the practice of green manuring is an ancient practice, being known to the Greeks and Chinese before the Christian era. Lupines, peas, vetch, lentils, and weeds were being turned under as green manures 2,000 years ago. Leguminous green manure crops, as well as buckwheat, oats and rye, were used by the American colonists.

When the 42,214 acres in the Tucumcari project were converted from native grassland to farm crops, the farmers found that their topsoil was only about 4 inches deep. For hundreds of years, it has been a semiarid region with sparse vegetation and low rainfall. These factors have allowed only a small amount of plant nutrients to return to the soil, resulting in a low organic matter content. Some of the farmers realized this and began a rotation program immediately.

Most of the progressive farmers on the project have used commercial fertilizers. At the Northeastern Experimental Substation, definite trends have been observed with its use, but the principal problem at the present is determining the most economical rates of application for row crops. The fact that superphosphate increases alfalfa hay yields is unquestionable.

Barnyard manure has also been successfully used when available. Don Fleming, another area farmer, used up to 3 tons per acre on his farm near Tucumcari to establish alfalfa on sandy soil.

On new land, a green manure crop is a valuable forerunner to commercial fertilizer because it builds up the organic matter and prepares the soil for higher production. While it increases crop yields, it also hastens the depletion of phosphates and the necessary minor elements. That is one reason why commercial fertilizers react favorably after a rotation program has been developed. All these factors combined increase the fertility of the soil, encourage diversification, make for higher production, and boost the cash income of the irrigation farmer.

# # #

Old-Fashioned

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by HERB JENKINS, Wenatchee Daily World

LOVE THY NEIGHBOR is the theme for this bit of house building near Moses Lake, Wash. (1) R. L. Ruggles, Myron Hartsentine, "E. P." Hamel, and Howard Knopp, on roof, and Jim Koba, on ground, are helping build a home for their new neighbors, Mr. and Mrs. W. E. Lane and family of 7. (2) Mrs. Lane and 3 of her 7 children, Johnny age 5, Mike 8, and Judy 7. (3) "E. P." Hamel, straw boss and organizer of the house raising. (4) W. E. Lane, former U. S. N. blimp pilot, busily saws lumber for his new home being erected on his farm. Son Mike looks on. *All photos by Herb Jenkins, Wenatchee Daily World.*

(*Editor's Note: Herb Jenkins is Bureau Chief for the Wenatchee Daily World in Ephrata, Wash., headquarters for the development of the 1,029,000-acre Columbia Basin project. Recently, Jenkins covered a story which explains more than any other reason the successful development that has started in this 4,000-square mile area of central Washington. The most modern American farm machinery is here being used to break the sagebrush to the plow, yet the old-fashioned pioneer welcome expressed in a house raising for a new family is more apt to be the final determining factor in the extent of this reclamation area's new wealth.*)

Early last March, Mr. and Mrs. W. E. Lane and three children (four others were left at home with grandma) of Mill Valley, Calif., drove up to their farm unit in block 40, 10 miles northeast of Moses Lake, Wash.

There it was—70 acres of sagebrush. No house, no well, no trees, no electricity, no nothing, just 70 acres of land unchanged since the days of the Indians.

The Lanes were tired. In addition to being fagged from their long drive from California, they were all just recovering from a siege of influenza.

2

ome for a Modern Basin Pioneer

Wearily they put up a tent and made up beds. A gust of wind blew the tent down. They put it up again, but all night long the wind howled and the canvas flapped and cracked. That was Tuesday.

Next day, Duane Cole came along, took one look at the tent and despite the protests of the Lanes moved them to an empty house trailer at his farm unit half a mile north.

Working long hours, Mr. and Mrs. Lane by Saturday night had poured a 22 by 22-foot concrete floor and foundation for a double garage which was to be used for a home during the year. They had hauled lumber, and had put up the side framework—all this in 4 days.

E. P. Hamel, a neighbor 1 mile west, came along on Wednesday. He stopped and introduced himself, visited a while, and then went on. Later in the day he stopped again. "I believe it would be a good idea if you folks would get most of your lumber here on the ground before you go any farther," he suggested.

"Why?" asked the Lanes.

"E. P." (he is known by his initials) shuffled his feet. "Oh, I thought it might save you a lot of time. Better get a big pile of lumber before you go any farther," he repeated.

The Lanes wondered why "E. P." insisted on this point, but said nothing.

In the meantime "E. P." was scurrying around lining up neighbors for a house raising for the Lanes on Sunday.

Sunday morning Mr. and Mrs. Lane started work as usual on the house. Helping them was R. L. Ruggles, Mrs. Lane's brother, who had driven down from Spokane for the day. The day was dark and cloudy, and a cold wind was blowing.

Soon the neighbors started to arrive. Myron Hartsentine, Jim Koba, Howard Knopp, and "E. P." Hamel all showed up with carpenter tools ready to go to work.

Rafters were cut for the roof and nailed into place. Sheathing was applied ready for the shingles, and part of the siding was nailed on.

By noon the crew had run out of sheathing for the roof. "Now you know why I kept yelling at you to get more lumber," Hamel boomed. "Never mind, I got some at home I've been saving for a chickenhouse. We'll bring it back after lunch. You can pay me back later."

"Come on, everybody," Hamel said, "we're all going to eat dinner at our house."

"That's right," said Mrs. Hamel, who had just arrived, "we've planned to feed the whole bunch."

Mrs. Lane demurred. "You folks have done enough," she said. "I have sandwiches and thermos bottles full of hot soup and coffee, and my husband and I and the kids will eat here."

"You'll do nothing of the kind," said the Hamels, and they literally boosted Mrs. Lane and the children into a car.

At the Hamel house Mrs. Howard Knopp and Miss Gloria Hartsentine were busy getting dinner.

4

Each had brought food from home as part of the dinner.

And what a dinner! A large roast of beef, mashed potatoes and gravy, vegetable salad, pickles, gallons of hot coffee, and a choice of lemon or coconut cream pie. These pies were man-sized, about 3 inches deep with lots of meringue on top.

The Lanes and the children and the carpenter neighbors ate at the first table. The three ladies, two Knopp children and your Daily World reporter ate at the second table. (We weren't behind the door when the brains were passed out—we learned long ago that those at the second table got the extra pieces of pie.)

Almost before anyone at the first table had finished his second cup of coffee "E. P." yelled, "Come on, you fellows. We can't build a house while sitting at the table. Let's get going."

By the middle of the afternoon the crew had started nailing shingles on the roof, and at the rate they were going the roof was completed by night. Lane, who is a carpenter by trade, finished applying the siding.

Mrs. Lane told us her husband was a Navy blimp pilot on antisubmarine patrol off the coast of California during World War II.

Among their seven children, there are two sets of twins. The three children they brought with them were Michael 8, Judy 7, and Johnny, age 5. Michael showed signs of coming down with the "flu" again Sunday, and was placed in a bed in the car during the afternoon.

Mrs. Lane said they hoped to get the land cleared during the year and a well drilled. She wasn't just sure what kind of crops they would plant first.

She blinked back tears and said, "I didn't know people could be so wonderful. They're the friendliest folks I have ever seen. We didn't know anyone when we arrived. Now we feel as if we had known them all our lives."

Your reporter could have told her this was not unusual for the Columbia Basin, and for block 40 in particular.

Just before we left town Sunday morning an Ephrata businessman said, "So you're going out to block 40. They're a fine bunch of people. They don't make them any better. But let me warn you, don't make one of 'em mad or you'll have to fight the whole outfit. I never saw such a gang to stick together."

We think he said it about right. # # #

HAMEL HOSPITALITY. Miss Gloria Hartsentine, Mrs. Howard Knopp, and Mrs. E. P. Hamel help to prepare dinner served at the Hamel home for the workers at the house raising for their new neighbors on the Columbia Basin project.

FARM SERVICE DELIVERY PIPELINE

by L. H. KRISTOF, Civil Engineer, Design and Construction Division, Region 2, Sacramento, California

Instead of irrigating land from open ditches, various private irrigation districts in California irrigate land by using unreinforced monolithically constructed concrete pipe for farm deliveries.

This method is used principally by the Modesto and Turlock irrigation districts in Stanislaus County, Calif., which have used this pipe for several years. Additional pipe is installed each year by these districts. To date, the Turlock irrigation district has over 200 miles of this pipe. During the past few years, other private water user agencies and ranchers in the Central Valley of California have also been incorporating the use of this pipe.

In general, the soils of the Modesto and Turlock areas are classified as "Fresno Sandy Loam." The successful irrigation of this soil requires the rapid application of a large head of water for a short period of time, the average application time being from 15 to 30 minutes per acre. In general, the pipe is designed to deliver an average of 15 cubic feet per second of water to each water user.

This pipe is generally used instead of lined canal for farm deliveries, when the cost of constructing the pipe is equal to or less than concrete lined canals for service deliveries of about 15 cubic feet per second.

This pipe is constructed in the following sizes:

Inside pipe diameter: *(Inches)*	*Shell thickness* *(Inches)*
24	2½
30	2½ to 3
36	3 to 3½
42	4
48	4 to 4½

Construction costs of 18- to 24-inch pipe approach costs of constructing 30-inch diameter pipe, since sufficient working space is not available and progress of work is slower. Pipe with diameter of 42 inches and over requires heavier form work, involves more difficult construction, with consequent higher costs. Thus, pipe with diameters of 30 and 36 inches are most commonly used—these sizes are the most economical where the land slope will allow a flow of 15 cubic feet per second.

The average pressure heads used in the pipe range from 5 to 8 feet, with a maximum in some cases of 10 feet.

Monolithic concrete pipe has the following advantages over canals, for farm service deliveries:

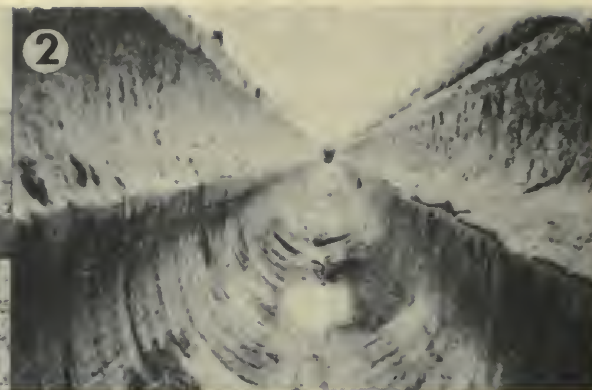
1. If properly designed and operated, no silt or sand deposition will occur. Adequate water velocities are usually provided to keep the pipe clean.
2. Since backfill over the pipe is about 18 to 24-inches the concrete is not subjected to wide or sudden variations in temperatures, which minimizes cracking.
3. Since the pipe interior is not exposed to sunlight, vegetation does not grow and less work or treatment is necessary to maintain the pipe at original capacity.
4. The entire right-of-way may be cultivated, making possible more complete use of the farm land and eliminating costly and unsightly bank weed growth.

The increasing demand for this monolithic pipe in the vicinity of Modesto and Turlock, Calif., has led to the establishment of numerous contracting firms for constructing these pipelines. To date there has been considerable competition for this work and as a result reasonable prices have been obtained.

Contruction methods vary only slightly among the individual contractors. These variations are limited to methods of removing forms or minor alterations of construction equipment and procedure.

In general, the procedure followed in the construction of this pipe is as follows:

1. Alinement and grade are established. Survey stakes indicating depth of excavation to subgrade are generally placed at 50-foot intervals in station and offset from the trench centerline a sufficient distance to allow equipment to excavate the trench.
2. Excavating equipment consisting of a trenching hoe or revolving type digger (see photo No. 1) is used to construct the trench for the pipe. The equipment constructs the trench bottom in a semicircular shape, with the diameter equal to the nominal pipe diameter plus the required allowance for thickness of the pipe shell. (Photo No. 2.)
3. Loose material is removed from the excavated trench bottom by hand. A semicircular shaped



template, conforming to the required trench bottom shape, is pulled along the trench bottom to check its size and to trim any excess earth.

4. Timber planks are placed across the trench at convenient intervals, and a timber runway (for wheelbarrows hauling concrete) is placed on the bank on one side of the trench.

5. Concrete is placed into the trench bottom ahead of and around the "boat." The boat is a movable semicircular steel form, the diameter of which is the same as that of the interior of the pipe. A workman stands on this form and rocks it while another workman, or a machine, pulls the form as construction progresses. (Photo No. 3.) It is necessary to exercise considerable care to assure proper thickness of concrete under the boat. No vibration or tamping of the concrete is performed other than what effect is produced by the rocking motion of the boat. The concrete must be of such consistency that the lower half of the pipe will retain its shape after the boat has passed.

6. As the boat passes along the trench, the interior surface of the concrete is generally steel trowled, completing the bottom half of the pipe.

7. The concrete for the top half of the pipe is placed, utilizing metal forms, as follows:

a. Immediately upon completion of the bottom half of the pipe, narrow pieces of lumber (usually 1 inch by 4 inches) are placed along the pipe bottom, for a walkway and for use as a bearing plate for lumber strips supporting the upper forms.

b. The forms for the upper half of the pipe are then set in place. These forms are usually 4-foot lengths of 20-gage (or heavier) sheet iron or aluminum that have been run through a roller press to give them a circular shape. The upper part of these forms is supported by lumber strips placed vertically and resting on the previously laid lumber in the pipe bottom. The arc of the forms is in excess of 180 degrees so that they extend sufficiently below the lateral centerline of the pipe. They are spread laterally and held in place against the previously placed bottom half of the pipe by a horizontal brace that extends across the inside of the pipe. Each section of form overlaps the previously placed section about 2 inches. The forms are oiled prior to placement, to facilitate their removal after pipe has been constructed. (Photo No. 4.)

c. Concrete is then placed over the forms to make the upper half of the pipe. The concrete is roughly shaped to the proper lines with shovels. (Photos 5, 6, 7.) A wooden hand float is used to work the material into proper shape, and final finishing is accomplished with a steel trowel. (Photo No. 8.) The required wall or shell thickness is maintained by checking the thickness with a wire gage.

8. As completion of the pipe progresses, backfill is placed over the pipe. Caution is exercised in placing the backfill over the pipe so that the fresh concrete is not injured.

9. The upper forms are collapsed the following day by removing the vertical and lateral supports. They are then removed from the pipe through openings that have been provided in the top of the pipe at about 100-foot intervals. After the forms have been removed, the openings in the pipe are patched or sealed with concrete.

10. General practice is to place about 50 feet of concrete for the bottom portion of the pipe, followed by constructing the upper part of the pipe. This process is repeated until the pipe is constructed. To assure a better bond between the two portions of concrete, a thin layer of grout is placed along the connecting surface before concrete for the top portion of the pipe is placed. (The average amount of pipe constructed per day is from 200 to 300 lineal feet.)

11. Appurtenant facilities such as precast pipe for valves, vents, and pipe stands, are installed at the time the pipe is constructed.

12. After sufficient time has elapsed, to allow for adequate setting of concrete, the remainder of the trench is backfilled.

The special equipment used in this method has not been standardized in detail and has been quite generally made up by each contractor or groups engaged in installing the pipe.

Prior to final acceptance of work by the irrigation district, the pipe is filled with water to the

Pipeline Continued

required head to test it for leaks. Contractors guarantee the pipe against leaks for a 1-year period.

The average 1952 prices for constructing unreinforced monolithic concrete pipe, by the method described above, which includes trenching, materials, placing pipe, and backfill (exclusive of structures such as stands, vents, valves, etc.) are as follows:

Inside Pipe Diameter:

(Inches)	*Cost per lineal foot*
24	$1.50 to $2.00
30	$1.60 to $2.25
36	$1.90 to $2.75
42	$2.90 to $3.25
48	$4.50 to $5.25

The governing factor in the operation is the precise degree of stiffness of the concrete at the time of pour.

# # #

COMMISSIONER'S OFFICES

Continued from page 7

MR. McCLELLAN, a native of Middletown, Ohio, is a veteran in years of service with the Bureau of Reclamation. Upon receiving his B. S. degree in electrical engineering from the University of Southern California in 1911, he joined the Bureau of Reclamation as Superintendent of Power on the Salt River project.

He served as a first lieutenant in the United States Army during World War I, returning to the bureau, after his discharge, as assistant electrical engineer at Denver. He has worked for the bureau continuously, with the exception of a brief term with the Southern California Edison Co., holding many top ranking positions. He has served as chief electrical engineer, assistant chief engineer, and Chief Engineer and Director of the Branch of Design and Construction. He held this latter post when appointed to his present position.

In recognition of his long and distinguished career as an engineering administrator, the University of Colorado conferred upon Mr. McClellan the honorary degree of doctor of engineering.

Mr. McClellan is a member of the American Institute of Electrical Engineers and the American Society of Civil Engineers. He has also been very active in international professional affairs and is a committee member of the International Conference on Large Electric High-Tension Systems.

He is a widower and makes his home in Denver, Colo.

MR. CROSTHWAIT has had over 30 years experience in handling administrative and personnel problems in the Federal Government. He is a native of Greenfield Center, N. Y., and received his B. S. degree in electrical engineering from George Washington University, Washington, D. C.

He began his public career in the Bureau of Ordnance, Navy Department, in 1916. He accepted a position in the Appointment Division of the Commerce Department in 1925, later serving as Chief of the Administrative Division, Aeronautical Branch, until 1934.

After a tour of duty as Administrative Assistant with the National Power Policy Committee, he joined the Interior Department. He was Director of Personnel for the Bureau of Indian Affairs from 1936 to 1941, leaving that post to become Executive Officer in the Office of Petroleum Coordination for War.

In 1942, he left that position for military duty, serving with the United States Air Force as a Colonel until 1946. Mr. Crosthwait also saw service in World War I as an enlisted man.

After World War II, Mr. Crosthwait transferred from his position with the Petroleum Coordinator's Office to become Associate Director of Supply for the Bureau of Reclamation in Denver, Colo. Shortly thereafter, he was promoted to the position of Director of Supply and was transferred to Washington, D. C. In this position, he was responsible for supplies used by the Bureau in carrying out a program that exceeded $350 million in a single year for multipurpose river basin water conservation in the 17 Western States.

MR. BLOODGOOD, a native of Newark, Nebr., is a veteran of more than 30 years service in the field of engineering and administration.

After receiving his B. S. degree in civil engineering from the University of Nebraska, he joined the Bureau of Reclamation as an assistant engineer at Mitchell, Nebr., in 1920. He continued with the Bureau in various engineering capacities until 1925 when he accepted a better position with E. E. White, county engineer, Orlando, Fla. In late 1926, he became construction engineer for the J. G. White Engineering Corp. in Mexico D. F. In this capacity, he was in charge of canal location and construction of a 60,000 acre project.

In 1929, Mr. Bloodgood returned to the Bureau serving in a number of engineering capacities ranging from assistant engineer to chief construction engineer, the position he held when he became associate chief engineer. He had continuous service with the Bureau since 1929 with the exception of 4 years (1942–46) in the United States Army. He saw military service in Europe and Iran, serving as a battalion and regimental commander with the Three Hundred and Thirty-fourth Engineers Regiment (SS). He was honorably discharged as a colonel in 1946.

During his tenure of office with the bureau after returning in 1929, he worked on the Riverton, Boulder Canyon, All-American Canal, and Central Valley projects, in addition to administrative engineering assignments in the Chief Engineer's Office at Denver.

Mr. Bloodgood is married and makes his home at Lakewood, Colo.

MR. SPENCER began his career with the Bureau of Reclamation in 1919, serving first on the Riverton, Wyo., project.

Prior to his present appointment as Regional Director, Region 2, Mr. Spencer served successively as supervising engineer, California projects; construction engineer on the Hungry Horse project in Montana; assistant engineer on the Echo Unit of the Salt Lake Basin project at Coalville, Utah; engineer on the Gooding division of the Minidoka,

project, Idaho; resident engineer on the Agency Valley Dam at Beulah, Oreg.; construction engineer on Burnt River project at Unity, Oreg.; construction engineer on the Fruitgrowers Dam at Delta, Colo.; and resident engineer and construction engineer on Deschutes project at Bend, Oreg.

Mr. Spencer's engineering career began with the United States Army in 1917. He served with the Second and Fifth Engineers' Divisions in France during World War I as master engineer, explosive specialist.

At the time of his appointment to the position of supervising engineer, California projects office, the present reactivated region 2, Assistant Secretary of the Interior Fred G. Aandahl said, "The Department of the Interior and the Bureau of Reclamation are most fortunate in having men of Mr. Spencer's caliber available for promotion to top positions in the Bureau."

MR. DOMINY has had more than 20 years experience in the administration of agricultural programs, both in State and Federal Government. He is a native of Hastings, Nebr., and a graduate of the College of Agriculture, University of Wyoming.

He began his professional career as a vocational agricultural instructor at the Hillsdale High School, Hillsdale, Wyo. In early 1934, he became county agricultural agent for Campbell County, Wyo., and continued in that position until September 1938. During this period, the area witnessed the worst drought and grasshopper and Mormon cricket infestation on record. As county agent, he was directly responsible for the administration of the several emergency programs sponsored by the Federal and State Governments to mitigate and alleviate the distressed conditions resulting. He became field agent for the western division of the Agricultural Adjustment Administration in 1938 with extensive administrative and technical responsibility in execution of the agricultural conservation and price support programs in the 11 Western States. He continued in this capacity until 1942 when he became Assistant Director of Food Supply Division, Office of the Coordination of Inter-American Affairs.

From April 1, 1944, to April 1, 1946, Mr. Dominy served as lieutenant in the United States Naval Military Government. He was assigned to the staff of Admiral John H. Hoover, commander of the forward area in the Central Pacific, and was the staff officer responsible for development and administration of agricultural programs placed in effect on the islands in the area immediately following reoccupation by our forces.

Mr. Dominy joined the Bureau of Reclamation in April 1946 as Chief of the Allocation and Repayment Branch of the Division of Operation and Maintenance. He became Assistant Director of the Division in 1950, and was promoted to Director on October 1, 1953.

Mr. Dominy is married and makes his home in Fairfax County, Va., with his wife and three children.

MR. BENNETT started with the Bureau of Reclamation on construction of the Kendrick, then Alcova, project in Wyoming in 1933.

He was subsequently employed by the Dan J. McQuaid Engineering Service, a consulting firm in Denver, Colo. In this capacity, he was engaged in the planning, design, and construction of municipal water supply systems in Sheridan and Cody, Wyo., the construction of various buildings in Denver, and the planning of sewerage disposal systems.

In April 1939 he became assistant state engineer of Wyoming, and also served as engineer secretary for the Wyoming Water Conservation Board. In these capacities, he was responsible for the planning and preliminary design of water use projects throughout the State, in addition to a number of other engineering activities.

He returned to the Bureau of Reclamation in 1942 as assistant engineer at Salem, Oreg. The following year, he was transferred to Denver in the office of the chief hydraulic engineer where he advanced through the grades of associate engineer and engineer.

In July 1945, Mr. Bennett was transferred to Washington, D. C., as Assistant Chief of the newly created Division of Engineering Surveys of the Branch of Project Planning. He was promoted to Assistant Director of the Branch in December 1946 and became Director in October 1953.

Mr. Bennett is a native of Sheridan, Wyo., attended Sheridan High School; Kemper Military Academy at Boonville, Mo.; and received his B. S. degree in civil engineering from the University of Nebraska. He is married, has two children, and makes his home in University Park, Md.

LETTERS

A Word From the Admiral

WASHINGTON 25, D. C.,
October 26, 1953.

DEAR SIR: Thank you very much for the copy of *Reclamation Era* for October and the fine article "Will To Work" included therein.

We deeply appreciate the continuing efforts of the Bureau of Reclamation in giving publicity to our program to employ handicapped citizens.

Thanks for your permission to reprint your material. We probably will include it in a future issue of *Performance.*.

Cordially,
ROSS T MCINTIRE, M. D.,
Chairman, The President's Committee on Employment of the Physically Handicapped, U. S. Department of Labor.

Inquiry From India

MYLAPORE, MADRAS 4,
August 31, 1953.

DEAR SIR: May we invite your attention to the paragraph on "Articles for Publication" in the enclosed pamphlet and as we are interested in publishing articles on irrigation, soil, power, etc., may we request you to grant permission to reproduce selected articles from "THE RECLAMATION ERA" occasionally. Thanking you,

Yours faithfully,
[S] G. N. ADINARAYANA RAO,
Chief Editor, The Architectural and Engineering Digest of India.

Reprint permission was gladly granted.—Ed.

Thank You, U. P.!

Washington, D. C.,
September 12, 1953.

Mr. J. J. McCarthy, Acting Editor,
THE RECLAMATION ERA.

DEAR MR. MCCARTHY: I wish to compliment you on the photography and typography of THE RECLAMATION ERA—particularly the July issue. This is really a neat job. Cordial good wishes.

Naborly yours,
HOWARD BLANCHARD,
Washington Representative, Union Pacific Railroad Co.

Development Farms from the Research Standpoint

AERIAL VIEW of irrigated fields and State Experiment Station plots on Redfield farm, South Dakota. *Photo by Chas. Knell.*

by DR. I. B. JOHNSON, Director
Agricultural Experiment Station
South Dakota State College

The Development Farm offers an excellent opportunity for the researcher to encounter and solve preirrigation development problems, and for the lessee or operator of the farm to put into practice, immediately and on a field scale, the answers found by the research scientists. The lessee's practice then becomes a demonstration to farmers of the area.

Development farms are, in effect, demonstrational-experimental farms developed by the Bureau of Reclamation and the Agricultural Experiment Stations in new areas being considered for irrigation. The demonstrational phase is provided by the main farm operations, conducted by the farmer-lessee on the main area of the farm. The experimental phase usually is conducted on a limited acreage on the farm by the State experiment station with the United States Department of Agriculture cooperating. This arrangement is found almost without exception on the irrigation development farms of the Missouri Basin.

Practical questions arise that cannot always be answered by referring to the results obtained in other irrigated areas. Differences in geographical location, temperature, precipitation, soils, drainage, and cropping systems are important factors affecting the success or failure of irrigation. Additional complications arise as irrigation moves eastward out of the arid into the humid areas.

Editor's Note: This is the second of two articles dealing with Development Farms in South Dakota. The first article, prepared by Bureau of Reclamation personnel and published in the June 1953 issue, discussed the purpose of the farms and the demonstrational phases of the program. In this issue Dr. Johnson has covered the subject from the research standpoint.

Some of the practical questions farmers in the Missouri Basin are asking are:

1. What will be the land leveling cost per acre?
2. When and how should irrigation water be applied to the different crops?
3. How much irrigation water should be applied?
4. How will the application of irrigation water affect the soil?
5. How extensive a drainage system will have to be installed?
6. What crops and varieties will give the best returns and how should they be managed?
7. What methods of planting and fertilizing should be followed?
8. What grasses and legumes are best adapted for pasture, for hay or for seed?
9. What are the fruit and vegetable crops that offer the greatest promise?

10. What are the crop disease and insect problems to be encountered and how can losses be minimized?

11. What livestock system fits best into the picture and is the most profitable?

12. What will be the annual cost for irrigation water being used to supplement rainfall?

13. How will the income from irrigated farms compare with that from nonirrigated farms?

14. Will there be satisfactory markets for the increased commodities produced?

The answers to these questions must be found and made public to avoid great losses to the farmers who are planning on irrigation as a new method of farming. They will be found through the efforts of the research agencies—the State experiment station and the United States Department of Agriculture—and through the opportunity for research to get started on the Development Farms provided by the Bureau of Reclamation.

Five years of research on the Development Farms in the James River Valley, South Dakota, has already uncovered a wealth of practical information. In the field of crops the present varieties of spring wheat have yielded about 27 bushels per acre under irrigation; oat varieties 77 bushels and barley varieties 53 bushels per acre. These yields exceed the yields of similar varieties grown under nonirrigated conditions by 39, 44, and 59 percent for wheat, oats and barley, respectively. A 3-year experiment on corn hybrids showed an average yield of 30 bushels on nonirrigated land and 65 bushels on the irrigated plots. It must be remembered that the present varieties were developed for nonirrigation farming and the yields show that new varieties designed for irrigation are needed.

One of the problems in this area has been the establishing of stands of grasses and legumes under irrigated conditions. Weed competition, excess moisture resulting from rains following irrigation, and compaction of the soil due to the use of heavy machinery and leveling equipment, all have resulted in stand failures. Only through research can these problems be solved so that legumes and grasses can play their part in a successful irrigation program.

In the fields of soil, fertilizers, and water and crop management, new techniques are replacing those ingrained from years of nonirrigated farming. For instance, it has been learned that optimum yields of corn are obtained only when the three factors—water, fertility, and plant population—are combined in the right amounts and at the right time. Corn needs water most at the stage from tasseling to silk browning; nitrogen requirements seem to be met most economically by side-dressing the crop when about a foot tall; plant populations of 18,000 to 20,000 plants per acre are necessary to realize maximum yields. Performance of nearly all nonleguminous crops under irrigation is limited by the soil nitrogen supply and sometimes by both nitrogen and phosphorus. For example, growth of irrigated grasses for hay and seed was found to be quadrupled by nitrogen applications up to 160 pounds per acre. Furthermore, protein content of hays produced under high fertility was nearly doubled in some cases, as compared with the nonfertilized grasses. Recovery of fertilizer nitrogen in the form of increased hay yields and increased protein was as high as 80 percent with some grasses.

Water required to produce various crops has also been the subject of much experimentation on these development farms. It has been found that plants are wasteful of water when the soil is kept moist up to the very surface at all times. Most economical usage of water by alfalfa was found to occur when the top 2 feet of soil was allowed to be depleted to the point of 85 percent of the available water being used, before irrigating the crop again.

Good quality vegetables have been grown under irrigation at the Development Farm with yields sufficiently large to give a high return. One year when irrigated tomatoes produced more than 10 tons per acre, nonirrigated tomatoes produced less than 200 pounds per acre. Tomatoes, cabbage and squash have so far ranked high as crops that could be grown and marketed on a commercial scale.

Both irrigated and nonirrigated pastures have been grazed by beef cattle to show the differences in pounds of beef produced per acre. These pastures included native grass, grass mixtures and legume-grass mixtures grown under irrigated and nonirrigated conditions. The native grass pastures were largely made up of western wheatgrass and blue grama with about 10 percent Little bluestem, feather bunchgrass and weeds. The tame pastures included such grass and legumes as bromegrass, Ree wheatgrass, Orchard grass, Kentucky bluegrass, Meadow fescue, Tall fescue, alfalfa, Ladino clover, Birdsfoot trefoil, Alsike

Tomatoes on Redfield farm averaged 18 tons per acre in 1951.

Corn yield in 1951 was 11 bushels per acre. *Photos by Knell.*

clover and Dutch white clover. Of these species, Orchard grass, Ladino clover and Birdsfoot trefoil were found to be nonwinter hardy. In one of the pastures in which Ladino clover was included in the mixture, losses were experienced due to bloat.

Each year the results of these research activities are shown to farmers on "Field Days," when they tour the farm. Often sprinkler and gravity irrigation can be shown on the same farm. This sort of procedure gives inexperienced irrigation farmers an opportunity to observe and adopt techniques which can save a great deal of expense and hard work.

In most established irrigation areas, experimental farms have been provided for by the United States Department of Agriculture in cooperation with the State Experiment Station, or by the Experiment Station, itself. In areas being considered for irrigation, the Bureau of Reclamation has cooperated by arranging for the temporary use of a farm or suitable land, on which research could be conducted to obtain essential information preceding the development of irrigation structures and the formation of irrigation districts. This appears to be a sound, business-like procedure in view of the fact that the irrigation development is merely in the planning or predevelopment stage. # # #

New Maps Available

Several new project maps have been recently completed by the drafting section of the Bureau of Reclamation. They are of the Boulder Canyon, Columbia Basin, Deschutes, Fryingpan-Arkansas, Lewiston, Orchards, Minidoka, Pine River, Solano, Sun River, Truckee Storage and Yakima projects. Also available is a three project map showing the Boise, Owyhee, and Vale projects.

All maps are in color and are available in the small and large sizes, except Boulder Canyon, Fryingpan-Arkansas, and Minidoka (small size only) (10½ by 17 and 21 by 34 inches). Requests should be sent to the regional director in charge of the project in which you are interested, specifying the name of the map or maps desired. Single copies are available free to those who need them in connection with their work or studies. (See list of Bureau offices on the back cover of this issue.) #

DO YOU KNOW . . . .

● On April 1, 1905, the Newlands project in Nevada became the first project constructed under the Reclamation Act of 1902 to deliver water for irrigation? Known until 1919 as the Truckee-Carson Project, it was renamed in honor of the late Senator Francis G. Newlands, father of the Reclamation Act.

SACRAMENTO VALLEY CANALS STARTED

Spearheaded by an impressive group of Federal, State, and local officials, about 5,000 Central Valley people gathered at Red Bluff, Calif., on October 17, 1953, to witness the ground-breaking ceremonies marking the beginning of construction on the Sacramento Valley Canals, Central Valley project.

The California delegation, headed by newly inducted Governor Goodwin J. Knight, included United States Senators William F. Knowland, Senate Majority Leader, and Thomas H. Kuchel; and *Representatives Clair Engle, coauthor of the bill authorizing the canals*, and John E. Moss. Representative Hubert B. Scudder was prevented from attending the ceremonies when his plane was grounded by fog.

The Department of the Interior was represented by Commissioner of Reclamation W. A. Dexheimer; Regional Director Clyde H. Spencer, Region 2, Sacramento, California; and Construction Engineer R. K. Durant, who will direct the work.

In delivering the main address, Governor Knight cited the concerted efforts which resulted in the authorization of the project. He said: "It is particularly pleasing to note that what we are celebrating today is the result of close cooperation between Federal, State, and local governments, aided by the constant efforts of your Sacremento Valley Irrigation Committee."

Commissioner Dexheimer stressed the importance of the continuing orderly development of California's water resources. "We all know," he said, "that there is plenty of water and plenty of potential power still subject to development in northern California— enough to meet all the ultimate requirements in the Sacramento Valley and still leave considerable water for export south. But the point is, these supplies have to be developed."

"A number of potential sources in the Sacramento River Basin might be tapped for this purpose. Reclamation believes the best of these is the proposed Trinity River Unit of the CVP."

The daylong celebration was marked by the usual parade and a hearty barbecue. A blast of dynamite, moving the first earth for an access road, signaled the beginning of actual construction. #

Top photo—Reclamation Commissioner W. A. Dexheimer addressing crowd at celebration. Center photo—l. to r. Mr. S. Pugh, Red Bluff, Calif.; Governor Goodwin J. Knight; Mr. Elmer A. Zuckweiler, Red Bluff merchant. Bottom photo—l. to r. Walter Stolly, former Mayor of Red Bluff; Senators Thomas F. Kuchel and William F. Knowland. *Top and bottom photos by A. G. D'Alessandro. Center photo by Wesley W. Nell, Region 2.*

MAJOR RECENT CONTRACT AWARDS

Spec. no.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DS-3716	Eklutna, Alaska	Oct. 12	Two 66-inch butterfly valves with operating units and handling equipment of government design for Eklutna power plant, schedule 1.	Mobile Stove and Pulley Mfg. Co., Mobile, Ala.	$73,174
DS-3948	Missouri River Basin, N. Dak.	Sept. 9	Four 230-kv circuit breakers for Bismarck substation	Brown Boveri Corp., New York, N. Y.	189,800
DC-3970	Solano, Calif	Aug. 7	Construction of Monticello Dam, appurtenant works, and relocation of State Highway 28.	Peter Kiewit Sons' Co. and Parish Bros., San Francisco, Calif.	7,628,991
DC-3980	Central Valley, Calif	do	Construction of earthwork, pipe lines, and structures, including pumping plants, for laterals 111.6W and 113.7W, and sublaterals, Unit 1, Delano-Earlimart irrigation district, Friant-Kern canal distribution system.	R. V. Lloyd & Co., Coachella, Calif	2,606,538
DC-3982	Cachuma, Calif	Aug. 24	Construction of earthwork, steel pipe lines, and structures for laterals 1 to 22, inclusive, Carpinteria distribution system.	Ofeco Construction Co., Inc., Long Beach, Calif.	343,552
DC-3983	Central Valley, Calif	Aug. 10	Stringing conductors and overhead ground wires for 20 miles of Folsom-Elverta 230-kv transmission line.	Malcolm W. Larson Contracting Co., Denver, Colo.	56,218
DC-3989	do	Sept. 1	Construction of earthwork, pipe lines, and structures, including pumping plants, for laterals 8.7 to 20, inclusive, and sublaterals, Plain View water district, Delta-Mendota canal distribution system.	Stolte, Inc., Oakland, Calif	441,893
DC-3991	Cachuma, Calif	Aug. 13	Construction of earthwork, steel pipe lines, and structures for laterals 10 to 16, inclusive, Goleta distribution system.	Ofeco Construction Co., Inc., Long Beach, Calif.	377,388
DC-3997	Missouri River Basin, Nebr.-Kans.	Sept. 2	Construction of earth lining for existing reaches of Courtland canal and earthwork and earth lining for relocated reach of Courtland canal, schedules 1 and 3.	Ray Millis, Omaha, Nebr	72,745
DC-4001	Columbia Basin, Wash	Dec. 9	Construction of earthwork, pipe lines, and structures for Area P-4 laterals (Block 13), Potholes East canal laterals, schedule 1.	United Concrete Pipe Corp., Baldwin Park, Calif.	1,063,159
DC-4007	Central Valley, Calif	Sept. 30	Construction of earthwork and structures for lateral and sublaterals, North section of Unit 3, Part 2, Madera distribution system.	Nomellini Construction Co., Stockton, Calif.	508,129
DS-4008	Missouri River Basin, S. Dak.	Oct. 16	Three 20,000/26,667-kva autotransformers with lightning arresters for Sioux City substation.	American Elin Corp., New York, N. Y	185,890
DC-4009	Columbia Basin, Wash	Sept. 30	Construction of earthwork and structures for West canal, Sta. 3257+62 to 4512+90; and Goose Lake wasteway, Sta. 0+00 to 45+77.37.	Otis Williams and Co., Kennewick, Wash.	490,285
DS-4011	Davis Dam, Ariz.-Nev	Nov. 5	Two 8,000/10,000-kva transformers with lightning arresters and one 12,500-volt, 91-ampere grounding transformer for Maricopa substation.	American Elin Corp., New York, N. Y.	99,885
DC-4016	Cachuma, Calif	Oct. 21	Construction of earthwork, pipe lines, and structures for lateral 17, Goleta distribution system.	J. E. Young Pipe Line Contractor, Inc., Los Angeles, Calif.	545,563
DC-4017	North Platte, Wyo.-Nebr.	Oct. 13	Construction of earthwork, asphaltic membrane lining, and structures for Fort Laramie canal, schedule 1.	Lichty Construction Co., Riverton, Wyo.	146,549
DC-4017	do	do	Construction of earthwork, asphaltic membrane lining, and structures for Fort Laramie canal, schedule 2.	Harry F. Berggren and Sons, Inc., Scottsbluff, Nebr.	106,318
DC-4018	Columbia Basin, Wash	Oct. 9	Construction of earth lining for West canal, fourth section, Station 2144+00 2364+00.	D and H Construction Co., Sacramento, Calif.	199,100
DC-4019	Milk River, Mont	Sept. 11	Repair of spillway at Fresno Dam	Long Construction Co., Inc., Billings, Mont.	140,368
DC-4021	Missouri River Basin, Kans.	Nov. 17	Construction of earthwork and structures for laterals 16.5 to 23.1, inclusive, sublaterals and drains, Courtland lateral system.	Claussen-Olson-Brenner, Inc., Holdrege, Nebr.	141,095
DC-4030	Columbia Basin, Wash	Nov. 16	Construction of earthwork, pipe lines, and structures for Eltopia Branch canal, Station 0+00 to 626+00; and north part of Area P-9 laterals, sublaterals, and wasteways, Potholes East canal laterals, schedule 1.	D and H Construction Co., Sacramento, Calif.	889,047
DC-4031	Central Valley, Calif	Oct. 28	Construction of earthwork and structures for lateral, Unit 3, Madera distribution system.	D and H Construction Sacramento, Calif.	419,765
DC-4035	Vermejo, N. Mex	Nov. 27	Construction of earthwork and structures for rehabilitation of Vermejo diversion dam, Vermejo canal, and Eagle Tail canal, utilizing precast-concrete pipe in siphons and wasteways, schedule 2.	Barnard-Curtiss Co., Minneapolis, Minn.	332,654
DC-4037	Middle Rio Grande, N. Mex.	Nov. 30	Channelization of the Rio Grande River in San Antonio and Escondida areas.	List and Clark Construction Co., Kansas City, Mo.	56,085
DC-4040	Central Valley, Calif	Nov. 17	Construction of 7-foot diameter horseshoe shaped Camino tunnel, schedule 1A.	T. E. Connolly, Inc., San Francisco, Calif.	322,910
DC-4040	do	Nov. 16	Construction of earthwork, pipe line, and structures for Camino conduit, schedule 4.	Engineering Constructors, Inc., South Gate, Calif.	1,075,508
DC-4043	Columbia Basin, Wash	Dec. 2	Construction of earth and concrete lining for fourth section of East Low canal and Lind Coulee wasteway.	Long Construction Co., Inc., Billings, Mont.	164,826
DC-4046	Yakima, Wash	Nov. 25	Construction of earthwork, concrete canal lining, and structures for Main canal.	A. J. Cheff Construction Co., Seattle, Wash.	272,547
DC-4047	Eklutna, Alaska	Nov. 24	Construction of Anchorage substation	City Electric of Anchorage, Inc., Anchorage, Alaska.	143,034
DC-4050	Vermejo, N. Mex	Nov. 27	Construction of earthwork and structures for rehabilitation of laterals and drains.	D. W. Falls Construction Co., Tulsa, Okla.	280,499
DC-4052	Missouri River Basin, Kans.	Dec. 11	Completion of Webster Dam	Edward E. Morgan Co., Inc. and Jones and Gillis, Inc., Jackson, Miss.	6,148,684
DS-4053	Missouri River Basin, N. Dak.	Nov. 12	Galvanized steel, single-circuit towers for Jamestown-Fargo 230-kv transmission line and ties for Watertown and Granite Falls substations.	American Bridge Division, United States Steel Corp., Denver, Colo.	736,82
DC-4055	Columbia Basin, Wash	Oct. 23	Repair of Feeder canal, Sta. 81+04.5 to 91+04	L. D. Shilling Co., Inc., Moses Lake, Wash.	194,721
DC-4059	Missouri River Basin, N. Dak.	Nov. 27	Construction of earthwork, structures, and surfacing for Buchanan and Edmunds roads.	Lindberg Construction Co., Jamestown, N. Dak.	80,258
DC-4060	Middle Rio Grande, N. Mex.	Nov. 30	Construction of earthwork, clearing, and structures for rehabilitation of 42 miles of open drains, Unit AW-1.	D. D. Skousen and Son, Albuquerque, N. Mex.	271,287
DC-4072	Davis Dam, Ariz.-Nev	Dec. 14	Construction of 44.25 miles of 115-kv transmission lines from Saguaro steam electric station to Phoenix-Tucson No. 2 tap, ED5 substation, and Oracle substation.	Elliott Construction Co., Omaha, Nebr.	427,940
100C-172	Minidoka, Idaho	Sept. 16	Construction of earthwork and structures for laterals from 11 wells, schedule 1.	Chase and Severson, Oakley, Idaho	56,446
100C-172	do	do	Construction of earthwork and structures for laterals from 10 wells, schedule 2.	James S. Trummell, Middleton, Idaho.	66,193
100C-177	do	Dec. 14	Drilling and casing 15 water supply wells near Rupert, Idaho, schedules 2 and 3.	Raymond Commons, Rupert, Idaho.	58,080
117C-203	Columbia Basin, Wash.	Aug. 4	Blanketing third and fourth section of Potholes East canal, station 2110+00 to 2529+00.	L. D. Shilling and Co., Inc., Moses Lake, Wash.	88,820
117C-205	do	Sept. 28	Construction of office, shop, and storehouse buildings and one 10-truck and one 10-car garage for Royal O&M headquarters	Nelse Mortensen and Co., Inc., Seattle, Wash.	120,426
300C-57	Davis Dam, Ariz.-Nev	Oct. 9	Construction of 230-kv additions, 115-kv and 12.5-kv installations, and control house at Prescott substation, schedule 1.	J. M. Montgomery and Co., Inc., Los Angeles, Calif.	133,985
600C-125	Missouri River Basin, Mont.	Sept. 28	Furnishing and erecting 10 three-bedroom relocatable residences for Tiber government camp, schedule 1.	Erickson Brothers, Inc., Kalispell, Mont.	74,114
704C-317	Colo.-Big Thompson, Colo.	Sept. 10	Construction of inlet channel modifications for Bald Mountain tunnel.	Winston Brothers Co., Minneapolis, Minn.	65,800

WORK CURRENTLY SCHEDULED[1]

Project	Description of work or material
Boulder Canyon, Ariz.-Nev	One 110,000-kva, 180-rpm, 16,500-volt, 3-phase, 60-cycle, vertical-shaft, alternating-current generator for Hoover Power Plant at Hoover Dam.
Buffalo Rapids, Mont	Constructing open and closed drains between Miles City and Glendive.
Buford-Trenton, N. Dak	Relocating main canal and a lateral, placing riprap, and constructing two small timber bridges southwest of Williston.
Cachuma, Calif	Constructing about 5 miles of 2½ to 10¾-inch steel pipe line for Summerland Distribution System near Summerland.
Central Valley, Calif	Completing Folsom Power Plant near Folsom will consist of installing non-embedded parts of three 74,000-horsepower turbines, miscellaneous metalwork, and electrical equipment in and on the power plant; erecting switchyard, and completing all other work, including architectural finish and heating and ventilating, for full operation of the plant.
Do	Completing Nimbus Power Plant about 7 miles from Folsom will consist of installing non-embedded parts of two 9,400-horsepower turbines; miscellaneous metalwork, and electrical equipment in and on the power plant; erecting switchyard; and completing all other work, including architectural finish and heating and ventilating, for full operation of the plant.
Do	Constructing 54 miles of 12- to 63-inch concrete pipe line for Unit 3 of the Delano-Earlimart Distribution System in the vicinity of Delano.
Do	Modifying oil supply system at Tracy Switchyard, 9 miles northwest of Tracy.
Do	Constructing switching facilities at Elverta Switchyard near Elverta.
Colorado-Big Thompson	Revising 69-kv facilities for 115-kv operation at Akron and Yuma Substations near Akron and Yuma.
Do	Installing two 6,000-kva transformers at Brighton Substation near Brighton.
Do	Installing about 2 miles of power line with underbuilt control cable at Bald Mountain about 10 miles west of Loveland.
Colorado River Front Work and Levee System, Ariz.-Calif.	Colorado River channelization work near Yuma, Ariz., will consist of excavating about 3,400 feet of channel, and furnishing and placing riprap.
Columbia Basin, Wash	Constructing about 70 miles of laterals for Area E-6 Distribution System near Othello.
Do	Constructing about 15 miles of unlined earth drains, Areas E-4 and E-5 near Warden.
Do	Constructing 60 miles of laterals for Area W-17 Distribution System north of Corfu.
Do	Ten vertical-shaft pumping units with capacities of 3 to 7 cfs and heads of 6 to 50 feet, for Area W-17 pumping plants.
Davis Dam, Ariz	Constructing Oracle Substation near Oracle.
Do	Furnishing and installing cooling systems for five generator exciters at Davis Power Plant at Davis Dam include ductwork, five 11,000-cfm centrifugal fan units, five 200,000 Btu heat exchange coils and five water pumping units.
Do	Fabricated, galvanized structural steel for bolted switchyard structures, Casa Grande Substation.
Eden, Wyo	Constructing this portion of Eden Canal, about 40 miles north of Rock Springs, will include 2.2 miles of unlined and 2.1 miles of earth-lined canal of 150 to 190 cfs capacities.
Do	Constructing West Side laterals and drains near Eden.
Fort Peck, Mont	Constructing 6,000-kva, 115/69/12. 5-kv O'Fallon Creek Substation near Fallon, and furnishing and constructing about 2 miles of 3-phase, wood-pole, H-frame 69-kv transmission line.
Fort Peck, N. Dak	Constructing 30,000-kva addition to Williston Substation near Williston.
Gila, Ariz	Constructing about 26 miles of unreinforced concrete-lined laterals for Unit 2 of Wellton Distribution System near Wellton.
Kendrick, Wyo	Constructing about 3,400 feet of buried asphalt membrane lining on Casper Canal, about 25 miles southwest of Casper.
Missouri River Basin, Iowa	Two 75-kva distribution transformers for Sioux City Substation.
Do	One 230-kv air switch, fifteen 69-kv air switches, and three 15-kv disconnecting fuses for Sioux City Substation.
Missouri River Basin, Minn. and S. Dak.	Constructing 205 miles of 230-kv transmission line between Big Bend, South Dakota, and Granite Falls, Minn.
Missouri River Basin, Mont	Seven 80- by 6-foot drum gates for Missouri Diversion Dam spillway.
Do	Three 16- by 6-foot top seal radial gates and hoists, Missouri Diversion Dam.
Missouri River Basin, Nebr	Constructing Third Section of Courtland, Ridge, and North earth canals near Superior.
Missouri River Basin, N. Dak	Replacing 7,500-kva transformer with 15,000-kva autotransformer at Washburn Substation near Washburn. Constructing 2-bay addition to existing 230-kv bus structure at Bismarck Substation near Bismarck. Constructing 60,000-kva addition to Jamestown Substation near Jamestown.
Do	Constructing 12.47-kv bay at Valley City Substation near Valley City.
Do	Five 230-kv air switches, two 115-kv air switches, and two 46-kv air switches for Jamestown Substation.
Do	Three lightning arresters for Jamestown Substation.
Missouri River Basin, S. Dak	Constructing 80,000-kva Oahe Temporary Substation near Pierre.
Do	Relocating gravel roads in Pactola Dam Site area near Rapid City.
Do	One 230-kv autotransformer for Watertown Substation.
North Platte, Nebr	Constructing reinforced concrete drop about 7 miles southwest of Mitchell.
Palisades, Idaho	Relocating 5.1 miles of Idaho State Highway No. 29 about 70 miles southeast of Idaho Falls.
Do	Clearing portion of Palisades Reservoir along Snake River southeast of Palisades.
Do	Two 125,000-pound-capacity radial gate hoists for Palisades Dam.
Palisades, Wyo	Relocating 4.2 miles of Wyoming State Highway No. 89 near Alpine, Wyo.
Riverton, Wyo	Constructing about 4 miles of closed drains and 4.5 miles of open drains about 25 miles northwest of Riverton.
Do	Channel relocation and erosion control on Fivemile Creek, about 20 miles north of Riverton.
Shoshone, Wyo	Constructing asphalt membrane lining on portions of Lateral R-4-S near Powell.
Weber Basin, Utah	Constructing Wanship Dam on the Weber River about 25 miles east of Salt Lake City. Quantities include about 4,000,000 cubic yards of excavation, 3,100,000 cubic yards of earth fill in the dam embankment, 8,000 cubic yards of reinforced concrete, and 71,000 cubic yards of riprap.
Do	Furnishing and placing 21 miles of 21- to 84-inch concrete pipe for Davis Aqueduct; furnishing and placing 4.5 miles of 42- and 48-inch concrete pipe for Weber Aqueduct, between Ogden and Salt Lake City.
Yakima, Wash	Three 7.25- by 7.40-foot fixed-wheel gates and two 1- by 10.7-foot fixed-wheel gates for Chandler Power and Pumping Plant.
Do	Radial gate hoist for wasteway ice sluice gate, Chandler Power and Pumping Plant.
Do	One 4,160- to 480-volt unit substation, Chandler Power Plant.

[1]This listing shows bid calls planned for January, February, and March, and is subject to change.

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The Reclamation Era

May 1954

IN THIS ISSUE:

Official Publication of the Bureau of Reclamation

The Reclamation Era

MAY 1954 Volume 40, No. 2

IN THIS ISSUE . . .

DESIGN AND ILLUSTRATIONS by Graphics Section
Bureau of Reclamation, Washington, D. C.

J. J. McCARTHY, Editor

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35 Years Ago in the ERA

PROPER USE OF WATER
A FACTOR OF SUCCESS

The wise and economical use of water must be the main concern of all interested in the development of the projects, as well as in the development of the arid and semiarid area of the country. In fact, it is not the quantity of water secured by irrigation structures that determines the area of irrigated land, but rather the manner in which the available water is used. The extent of reclamation, the character of agriculture under the ditch, and the permanence of a civilization built upon irrigaton, depend upon the use of irrigation water; that is, upon irrigation practice.

* * *

THE NEXT QUARTERLY ISSUE of the ERA will appear in August.

They Plant and Harvest THE YEAR AROUND

by MAURICE LANGLEY, Lower Colorado River District, Region 3, Yuma, Arizona

Newcomers to southwestern Arizona never cease to be impressed when farmers from Yuma brag. . . . "We plant and harvest crops every month of the year."

For years farmers in the Yuma area have helped northern plant breeders "gain a year's time" by growing seed increase of northern crop varieties during the winter months while the northern areas are under a blanket of snow and crops are dormant. Quite often the time schedule is very close. A few pounds of some special selection of grain may be harvested up north in late August or early September, shipped to Yuma for planting in November or December, harvested again in late April, and returned to its northern habitat for a spring planting in May. However, this routine is getting to be old stuff for many farmers in the Yuma area.

In the winter of 1945–46 Rescue wheat seed was increased to help the farmers of the Northern Great Plains combat damage from wheat stem sawfly. In the winter of 1946–47 over 800 acres of peas were grown to help provide seed for the spring planting in Oregon and Washington. That same fall an acreage of special seed increase of Bonda and Mindo oats was grown for a Minnesota seed company. During the winter of 1948–49 the seed increase of Moore barley on over 1,000 acres in the Yuma area provided improved seed for many a northern grower. For the next two winters there was emphasis on oats from the plant breeding departments of Iowa and Indiana. Growers like Ernest Johannsen and Frank Johnson in the Yuma Valley have seldom missed a winter in recent years without some special seed

increase contract with one of the Northern States' agricultural experiment stations.

This year the greatest emphasis was on a new rust-resistant spring wheat known as CT–186. It was developed by a group of Canadian plant breeders, plant pathologists and cereal chemists, with the work centered at the Dominion Laboratory of Cereal Breeding, University of Manitoba, Winnipeg, Manitoba. CT–186 has resulted from a series of crosses and selections dating back to 1938. The initial cross was between McMurachy and Exchange varieties, and the resulting selections were labeled RL 2265. This selection was in turn crossed three times with Redman, a variety well-known for its high yield, baking, and milling qualities. The resulting CT–186 derives its stem rust-resistance from McMurachy and Redman, and its leaf rust-resistance from Exchange. It is this resistance to the races of stem rust commonly found in Canada, including the present prevalent strains of 15B rust, that make CT–186 so much in demand, particularly in Manitoba and eastern Saskatchewan.

Dr. A. B. Masson, Cerealist from the Dominion Laboratory, has been doing cooperative work for a number of years with Agronomist V. E. Comstock of the Southwest Irrigation Field Station at Brawley, Calif, and it was Mr. Comstock who suggested that the CT–186 seed increase be spread between the Yuma Mesa, Yuma Valley, and Imperial Valley. Contacts with growers in the Yuma area were made through the Yuma County Pureseed Association headed at that time by Mr. Ralph S. McGill, an outstanding Yuma Mesa farmer.

After accepting applications from local farmers, it was decided that entrymen Gerald L. Didier, Herman A. Reeves, and Richard M. Lynch of the Yuma Mesa Unit of the Gila Project would plant 10, 28, and 20 acres, respectively, while Fred Watkins and Bill Thacker in the Valley Division of the Yuma project would plant 25 and 20 acres, respectively. An additional 50 acres were grown in the Imperial Valley near Holtville, Calif. About 150 bushels of seed were shipped to Yuma in November 1952 and planted shortly thereafter. Although not particularly adapted to the warm southern climate, the wheat made good growth and responded rapidly to the fertilizer and irrigation treatments, as recommended by the local county agricultural agent, Al Face.

DR. A. B. MASSON, Cerealist, Dominion Laboratory of Manitoba, is one of the developers of rust resistant CT–186, Spring Wheat. ***Photo by S. B. Watkins, Region 3.***

Harvest was started in early May 1953 under the direct supervision of Dr. Masson. Part of the acreage was swathed and allowed to dry in the windrow, and part was combined direct even though it still contained many green kernels and had to be dried before rapid shipment to Canada. By the middle of May about 5,000 bushels of CT–186 had been returned to Canada and planted on selected farms and experiment stations for further seed increase under the control of the Canadian Department of Agriculture. After a few more quality tests, it is expected that the new variety will be licensed and named. It looks like about 120,000 bushels of the new variety will be available to Canadian farmers for the 1954 seeding.

Thanks to the sunny winter climate of southern Arizona and California, many Canadian farmers will have protection one year earlier against attack of 15B stem rust on their spring wheat crop!! # # #

THE TUCUMCARI TRANSFER

by WILLIS C. BOEGLI, Irrigation Division, Region 5, Amarillo, Texas

A new home is finished. The builder moves out, and the new owner's family moves in. That is a thrilling moment in the life of any family.

It was a thrilling moment when the landowners of the Tucumcari project in New Mexico moved into the full operation and maintenance of their project at the beginning of 1954. The Bureau of Reclamation had practically completed their work in building the $16,000,000 irrigation project, which carries water from the Conchas Reservoir on the Canadian River and delivers it to 42,214 acres of land, when the conservancy district assumed full management of the project. This move had been planned for several years and conforms to the Bureau policy of turning projects over to the water users as soon as they are willing and financially able to assume operation and maintenance.

The landowners, represented by the Board of Directors of the Arch Hurley Conservancy District, assumed full operation and maintenance of the entire project, including the irrigation system, office building, warehouses, ditchriders' houses, and all maintenance equipment. The board of directors, at the time of the project takeover, were Earl George, president, and members George Eager, Arch Hurley, C. L. O'Quinn, and Jessee Williams. Mr. James L. Briscoe is the attorney for the Board and Mr. Benj. Munoz is the secretary-treasurer. The Board selected Albert Mitchell, a project landowner, as their first manager. Mr. Mitchell is a native of eastern New Mexico, an agricultural and engineering graduate of New Mexico A & M College and was the 1953 president of the Water Users' Association.

Mr. Bert Levine was the project manager for the Bureau of Reclamation at the time the project was turned over to the water users. Mr. Levine will remain on the project until June 30, 1954, to complete the construction of the drainage system, which will bring to an end all Bureau of Reclamation construction activity on the project. The board of directors showed foresight and wise planning in preparing for an orderly assumption of the project's operation. They employed their new manager several months prior to the actual takeover in order that he could become acquainted with the project prior to assuming management. Mr. Mitchell and Mr. Levine worked together during the late months of 1953 and were able

ARCH HURLEY CONSERVANCY DISTRICT BOARD DIRECTORS
Front row, left to right—Earl George President, Directors, George Eager, Jesse W. Williams, C. L. O'Quinn, and Arch Hurley. Back row, left to right—Albert M. Mitchell, District Manager, Benjamin Munoz, Secretary-Treasurer, James L. Briscoe, Attorney, Mrs. Irene Kearns, Clerk, and S. A. Crane, President, Water-users Association. ***Both Photos by Bert Levine.***

ARCH HURLEY CONSERVANCY DISTRICT FIELD PERSONNEL
Front row, left to right—A. E. Orthman, Fred A. DeOliviera, Jerry Wignall, Jewell P. Roberts, Oran W. Batson, Homer C. Hall, Raymond G. Martinez, Isaias J. Dominguez, Taylor B. Woody. Back row, left to right—Robert Mowles, Harvey Sprinkle, Willis L. Hogan, Andres Paiz, Tony J. Ortega, David E. Garcia, Ernest Dominguez, Francisco M. Garcia, Abe N. Marquez, Billie J. Stratton.

to effect a smooth transition from Government to district operation.

Early in the construction phase of the project, the Bureau established a permanent office building in Tucumcari, which has housed their office organization all during the construction period. The new district organization moved into this building when they assumed operation of the project.

Since 1946, when water was first delivered and 2,500 acres were irrigated, settlers have brought 35,783 acres of desert land under irrigation and have produced crops valued at $9,500,000. For the past 3 years the value of crops has averaged $2,000,000 per year. Under full development, and with the inclusion of livestock enterprises, the gross income from project farms is expected to approach $4,000,000 a year. Alfalfa, broom corn, castor beans, cotton, grain sorghum, and irrigated pastures are the major crops.

During the early years of the project's development, the Bureau of Reclamation contributed to the construction of an irrigation experiment station and the employment of an irrigation specialist to work with the State Extension Service in the county. The New Mexico State A & M College is assuming the major responsibility of continuing these services, and the irrigation district and all other Federal and State agencies interested in the development of the project are cooperating. These two services are very valuable to the agricultural progress of the project.

The district is endeavoring to assure the proper operation and maintenance of the project by employing experienced personnel. The new manager, Albert Mitchell, is an engineer with actual farming experience on the irrigation project. He has selected an experienced watermaster, Mr. Jerry Wignall who was previously employed on the Pershing County Water Conservancy District at Lovelock, Nev. The district has retained a number of employees who have been on the project with the Bureau of Reclamation for several years. Included among these is a young engineer, Billie Stratton, who will direct the maintenance phase of the district's operation. Other Bureau employees retained by the district are Ruby Smith, purchasing agent, Bertha Gartner, water clerk, three ditchriders, and practically the entire maintenance force. The other Bureau of Reclamation employees have been transferred to other Bureau irrigation projects, except for a small organization which remained to complete the construction. Two district employees have been retained in the new organization. These are Mr. Newton V. Nix and Mrs. Irene Kearns. Mr. Nix, in charge of the land and water right records for the district, initiated this work while an employee of the Bureau, but became an employee of the district 7 years ago when the district assumed responsibility for keeping land and water right records. Mrs. Kearns, in charge of the finance section, has been in the district's employ for the past 8 years.

One of the last construction jobs completed on the project was the installation of emergency pumps at the reservoir to supply water to the canal when the reservoir elevation was near or below the outlet gates. This assures the project 20,000 acre-feet of additional water in a dry year when the reservoir is low.

The Tucumcari project is now in a development period during which time landowners will pay only the cost of project operation and maintenance. In 1959, at the end of this development period, the district will start payments on its construction obligation to the Federal Government.

The rapid settlement and development of the project has been due to the labor and high interest of the farm families, assisted by Federal and State agencies, including the Soil Conservation Service, PMA Extension Service, Experiment Station, and Farmers Home Administration.

The best wishes of the entrie Bureau of Reclamation go to the project farmers and their district organization as they assume full responsibility for the project. # # #

REGIONAL CONFERENCE ON CLAYS AND CLAY TECHNOLOGY SCHEDULED

The committee on clays and clay technology of the University of California is sponsoring the 1954 Pacific Coast Regional Conference on Clays and Clay Technology at Berkeley, Calif., on June 25 and 26. This year's meetings will center around the clay-water system and should be of especial interest to technicians dealing in such problems in soil mechanics as swelling pressures, water movement in clays, and the sealing of ditches and dams.

Additional information on the meetings may be received by addressing Prof. Joseph A. Pask, Division of Mineral Technology, University of California, Berkeley 4, Calif.

Chemicals Cure Seed Crops

SPRAYING ALFALFA with dinitro-ortho-secondary-butylphenol (dinitro for short) at rate of 1.25 pounds of chemical in 10 gallons of diesel fuel per acre. *All photos in this article courtesy of W. M. Phillips, Fort Hays Experiment Station, Division of Weed Investigations, U. S. Department of Agriculture.*

by VAL E. WEYL, Editor, National Agricultural Chemical News

Editor's Note: We wish to express our appreciation to the National Agricultural Chemicals Association, located at the Barr Building, Washington 6, D. C., for making the following article available to the *Era*.

Observant farmers have known for a long time that harvesting operations to recover alfalfa seed cause a great deal of loss in seed production due to the numerous unavoidable operations to complete the harvest—cutting, windrowing, turning, stacking, and threshing. The trigger mechanism of the dry seed pods is often released under these mechanical operations and the seed is widely scattered. In addition, some of the seed pods break off where they are attached to the plant. The total loss might be many precious pounds per acre, for at times as much as 90 percent of the total crop of seed is not recovered.

It becomes a logical question, "Why can't we eliminate some of these operations, adjust the combine to handle this small seed, and combine our alfalfa? Couldn't we thus save the seed that is now lost?" Some farmers tried it.

But alfalfa keeps on growing and blossoming, once it starts, until something stops it. So at times the combine would have to chew through green stems, leaves and new blossoms, mixing all with the ripe seed and clogging the equipment.

Under irrigation, ripening can be controlled better than in areas of natural moisture; but control of irrigation is only partially effective; it cannot give the clean and well-timed "brownout" that is needed for a really thrifty seed harvest obtainable with a combine.

Against this background, and urged on by rising prices of wanted strains of legume seed, of which alfalfa is a good example, some people of inquiring mind tried chemical weedkillers on the crops. The systemic weedkillers were ruled out at once—they killed the alfalfa plants.

One chemical has given results of very satisfactory uniformity; has knocked off leaves; has reduced moisture content; has left seed pods, for the most part, attached to the upstanding plants and has in general conditioned the plants ideally for combine harvesting. Fields sprayed with it at proper rates have shown no injury, even after several years of the practice.

This chemical is dinitro-ortho-secondary-butylphenol, dinitro (dye-nye-tro) for short. A rich, intense yellow in the spray tank, it mixes with water or oil. Under conditions of practical use it has presented almost no problem to other crops in nearby fields. This "dinitro" has given highly satisfactory results in both tests and field practice for preharvest treatment of alfalfa, red clover, Ladino clover, alsike clover, and trefoil raised for

Top photo shows CONTRAST between dinitro treated alfalfa at left and untreated at right. Center photo: Picking up windrows with a combine. Immediately above: Cutting alfalfa with a conventional mower with windrow attachment followed by tractor with special attachment to press down windrow and thus reduce danger of scattering by wind.

seed. As much as 70 pounds more seed per acre were obtained from treated plots over conventional harvesting methods.

Careful timing pays off. The spray should be applied at the same time as for normal windrowing, or preferably a day or two later. The chemical does the curing job in from 24 to 72 hours depending on weather, but harvest should be completed within 10 days after spraying. With most legumes very little seed loss may be expected for the first 4 or 5 days after spraying; but after the 8th to 10th day seed loss may be of serious proportions.

Rates of application vary with the crop to be treated, the method of application and weather. A standard application applied with an airplane, is 2 to 3 pints of the chemical in 4 to 10 gallons of diesel or fuel oil per acre. If the material is applied with ground equipment, 2 to 3 pints may be applied in 8 to 15 gallons of oil per acre. Where high volume spraying with ground equipment is desired, 25 to 40 gallons of water may be emulsified with good agitation with the oil solution.

The high rates and volumes are needed for use during cool, cloudy weather and/or where there is rank, heavy foliage growth. Best results are achieved during warm, sunny weather.

Packages in which the chemical is sold commercially carry directions relating to its use. Precautions for safe handling and use should be followed carefully.

Questions have been raised about the germination of the seed so conditioned before harvest. In 1951 in California more than 6 million pounds of alfalfa seed were harvested from fields so treated prior to combining, and no cases of reduced germination were recorded. Where the chemical hits truly immature seeds, they are killed; but they are usually so light in weight that they would be rejected in combining, anyway.

Research in Kansas has shown that seed loss from unsprayed alfalfa plots in 1 representative test ran about 195 pounds per acre, while from dinitro-sprayed plots this loss was only about 15 pounds per acre. The difference of 180 pounds per acre easily paid for all costs of spraying and showed a nice profit. Results on western irrigated lands are similar.

Conditions under which preharvest conditioning is not advisable have not been clearly determined. To the present time, the profitable results have accounted for its increasing use in most legume-producing areas, both in this country and in Canada.

# # #

From Agricultural to Residential

by ARLIE S. CAMPBELL, Secretary of the South Ogden Conservation District, Ogden, Utah

When the Ogden River project was planned in the early thirties, it was decided to construct a small concrete lined canal to irrigate a crescent shaped area of land along the foothills east and south of Ogden, Utah. The decision to construct the canal was made by the late Reclamation Commissioner Dr. Elwood Mead as he stood on top of the Ben Lomond Hotel in Ogden with a group of the project promoters looking over the landscape.

Under the direction of Ora Bundy, president of the Ogden River Water Users' Association, and through the activities of attorney L. J. Holther, these lands, consisting of about 2,000 acres, were organized during 1935 into a conservation district under the laws of the State of Utah. The South Ogden Conservation District, which has since become a guinea pig in reclamation, came into being. Three of the large landowners formed the first board of directors—William P. Stephens, John M. Mills, and Joseph E. Wright.

At the time of organization the district lands were largely agricultural in character. It was not long, however, until the population of the area grew by leaps and bounds, and new homes were needed quickly. The Government and private agencies went into the business of housing construction, and the South Ogden Conservation District found itself directly in the path of housing development. As soon as the lands were subdivided the owners of the new homes still wanted water to irrigate lawns, shrubs and gardens. The changing requirement for water delivery led to detailed surveys and investigations in 1938 to determine the most satisfactory means of meeting the new demand. Engineer Norman T. Olsen was sent to Ogden in the fall of that year to take charge of the investigations and to later construct the system.

The terrain embraced within the district was such that most of the lands were considerably lower in elevation than the canal, thus making it possible to deliver the water under pressure. Therefore, it was tentatively planned to convey the water through steel pipes under pressure to the residential area, which at that time was only a small fraction of the entire district. The balance of the district was to be served through low-pressure concrete pipe.

Mr. Carl Vetter was sent out from the Chief Engineer's office at Denver to confer with Mr. Olson regarding some of the engineering prob-

WASATCH RANGE serves as backdrop for homes with gardens and small orchards receiving water supply through South Ogden system. ***Photo by J. R. Hinchcliff.***

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lems. As soon as Mr. Vetter looked over the project, he strongly recommended that the entire system be constructed with high-pressure steel pipe. He said that if this were not done the system would be obsolete before it was completed. Mr. Vetter's recommendations were followed and subsequent developments vindicated his judgment.

By 1940 appropriations were obtained and a repayment contract was executed with the Bureau of Reclamation for construction of the pipe system. The system as completed in 1942 consisted of approximately 35 miles of spiral welded steel pipe (wrapped and dipped) varying in sizes from 4 to 22 inches. The system was designed to convey water to the high point of each ownership as it existed at that time.

With the outbreak of World War II, several large military installations were established near Ogden, making a greater demand for housing. In fact, the availability of relatively cheap irrigation water was a powerful incentive to bring development into the district. Further subdivision of the lands made it necessary to place numerous pipeline extensions. In fact, pipeline extensions have posed a major problem in water distribution. However, from the beginning district officials pursued a policy of insisting that all pipeline extensions be either built by or financed by the landowners who benefited therefrom, and in accordance with district standards and specifications. Where the job was done by contract, the plans and specifications were prepared by the district.

In some instances, the promoters of subdivisions were induced to construct the necessary extensions. In other cases, it was necessary to get groups of landowners together to accomplish the work. While district officers were active in much of this organization work, they kept out of the construction business.

Two enlargements have now brought the area of the district to 2,700 acres.

Indicative of the conversion of the area to a residential one is the fact that while there were fewer than 1,000 tracts of land in the district when it was first organized in 1935, there are now in excess of 6,500 individual ownerships. There are more than 4,000 connections to the system.

After the close of the war, Superintendent David A. Scott saw the need for additional equalizing reservoirs to meet the fluctuating demand occasioned by residential irrigation use. Accordingly, under a new contract the Bureau of Reclamation constructed three additional reservoirs with interconnecting pipelines. The 5 reservoirs now have an aggregate storage capacity of 15 million gallons.

TYPICAL of the spacious yards and gardens in residential Ogden and South Ogden. ***Photo by J. R. Hinchcliff.***

In compliance with an order from the State Board of Health, district officials installed a chlorinator at the head of the South Ogden Canal so that all of the water used by the district is chlorinated before it discharges into the equalizing reservoirs. This has an additional effect of keeping moss and algae from growing in the canal.

Under the Utah law, each tract of land in a conservation district is allotted a definite or fixed amount of water, measured in acre-feet. The allotment represents the estimated amount of water necessary for a full and complete irrigation water supply for one season. The county assessor then assesses the lands on the basis of the allotments.

It is further provided in the law that the Board of Directors of the district may, if it so chooses, divide the district into zones or subdivisions and may fix for assessment purposes a different value per acre-foot of water within the different zones.

In order to make the project economically feasible, the South Ogden Conservation District has resorted to this provision in the statutes. In 1952 there were 6 such zones or units and the water tax varied from $2.90 per acre-foot in the lowest unit to $10.15 per acre-foot in the highest. These water taxes are collected by the county treasurer who is the ex officio district treasurer.

Although these charges for water may appear somewhat high, it should be remembered that the highest rate applies only to highly developed

Continued on page 38

FIVE NEW OFFICIALS APPOINTED

Reclamation Commissioner Dexheimer recently announced the appointment of five new staff officials. They are:

Frank M. Clinton, Regional Director, Billings, Mont., succeeding Kenneth F. Vernon as Director of Region 6.

R. J. Walter, Regional Director, Denver, Colo., succeeding Avery A. Batson as Director of Region 7, Denver, Colo.

J. R. Riter, chief development engineer, project investigation division, with headquarters in Denver, Colo.

William L. Newmeyer, chief of power operations division, with headquarters in Denver, Colo.

William R. Foster, Comptroller, with headquarters in Washington, D. C.

The position, to which Messrs. Riter and Newmeyer were appointed, are new posts. The position of Comptroller was a vacancy at the time of Mr. Foster's appointment.

Above (left to right) Regional Directors Frank M. Clinton, R. J. Walter, and Chief Development Engineer J. R. Riter. At right Chief of Power Operations William L. Newmeyer and Comptroller William R. Foster.

MR. CLINTON is a native of Arizona and a graduate of the University of Arizona in civil engineering. He joined the Bureau of Reclamation in 1937 as an inspector on the Bartlett Dam on the Salt River project in Arizona. In February 1939, he was named assistant engineer in charge of investigations for the Big Horn project in the Missouri River Basin with headquarters at Worland, Wyo. This area will be under his administration in Region 6.

In June 1942, he moved to Idaho Falls, Idaho, where, as associate engineer, he worked out plans for the complicated Palisades water distribution system, during which assignment he gained a wide background in dealing with water users' problems. He moved to Boise as assistant project planning engineer in 1944 and has been assistant regional director since July 1, 1949.

MR. WALTER, who is a native of Denver, attended the University of Colorado and the New Mexico School of Mines, graduating from the latter school in 1926 with a B. S. degree. Following his graduation, he joined the staff of the Rio Grande conservatory district at Albuquerque, N. Mex., and served as assistant engineer and superintendent of construction until 1935. After serving a year as civil engineer with the International Boundary Commission at El Paso, Tex., he joined the Bureau of Reclamation as construction engineer on the Caballo Dam, N. Mex.

He served as construction engineer on the Tucumcari project in New Mexico, the Balmorhea project in Texas, and the Cedar Bluff Dam in Kansas. He became chief of the engineering division in the Lower Platte River area office at Grand Island, Nebr., in 1951 and a year later became construction engineer on the Webster Dam.

In 1952, Mr. Walter received the Department's distinguished service award for resourceful and unique action possibly saving lives and greatly reducing property damage in the 1951 flood of Big Creek through the Kansas towns of Ellis and Hays. (See the October 1951 issue of the RECLAMATION ERA for Air-Borne Flood Warning.)

MR. RITER, a native of Logan, Utah, is a veteran in years of service with the Bureau of Reclamation. After receiving his bachelor of science degrees in geology and civil engineering from the Utah State Agricultural College at Logan, Utah, he worked as a soil surveyor in the State of Utah.

In April 1928 he joined the Denver office of the Bureau of Reclamation and has been continuously employed with increasing degrees of responsibility since that time. His assignments have been in project planning and hydrology. He was a director of the branch of project planning for a period in 1945 until he became chief, hydrology branch, project planning division. He held this latter position at the time of his present appointment.

As chief of the hydrology branch, he was a responsible staff officer of the Commissioner and furnished technical advice to regional and project offices on hydrology matters, formulated standards and procedures for hydrologic matters in project planning reports, and reviewed these reports.

He has also authored or co-authored or assisted on project planning reports on many Bureau projects built, under construction, or proposed since 1930. He assisted in the reconciliation of the Bureau and Corps of Engineers plans for the comprehensive development of the Missouri Basin. Subsequently, he served as a member of an Adequacy of Water Committee for the Missouri River Inter Agency Committee.

MR. NEWMEYER has had more than 35 years' experience in the field of electrical engineering, both in the United States and abroad.

He received his B. S. degree in electrical engineering from the Case School of Applied Science (now Case Institute of Technology) and his M. S. degree in electrical engineering from the California Institute of Technology. Following graduation, he joined the Westinghouse Electric & Manufacturing Co. where he was employed for 14 years in the United States as engineer, and special representative of Westinghouse International in China and Japan.

In 1933 he entered the service of the Bureau in the Chief Engineer's office at Denver, Colo., working on design and construction of Reclamation hydroelectric developments including Boulder Canyon, Columbia Basin (Grand Coulee), Central Valley (Shasta and Keswick). He became chief of the resources and development branch of the power utilization division in 1944.

Prior to transferring to the Bureau's Washington office in 1946, he served as a member of the F. A. O. Commission of the United Nations which visited Greec and prepared a report on the resource of that Nation.

He was promoted to the Assistant Di rector of Power Utilization in 1951.

Mr. Newmeyer is a member of Ta Beta Pi and Sigma Xi, and a fellow o A. I. E. E.

MR. FOSTER, a native of Minneapo lis, Minn., is a graduate of the School o Business Administration, University o Minnesota, with a Bachelor of Busines Administration degree and an account ing major.

He has had diversified experience a an accountant and auditor for the pas 25 years, of which almost 6 have bee with the Bureau as Assistant Directo of Programs and Finance, and 6 as a auditor with the Federal Power Com mission. Prior to that, he worked abou 14 years as an operating accountan with a major public utility. As chief ex aminer of accounts for the Power Com mission, Mr. Foster planned, organized and directed the audits of many majo utility companies under the jurisdic tion of the Commission.

From 1928 to 1937 he worked as a accountant for the Northern State Power Co., Minneapolis, Minn., durin which time he obtained experience i all phases of general utility accountin operations. During the next 5 year with this company he was assigned t the vice president and treasurer's offic as a special accountant to assist in prep aration of reports to the Securities an Exchange Commission and other regula tory agencies and to make special finan cial studies of the system companies.

Mr. Foster is a member of the Delt Sigma Pi professional business frater nity, and the Federal Government Ac countants Association.

Correction

DEAR SIR: While reading the Febru ary 1954 issue of the *Reclamation Era* I noticed on page 22 that the captio under the picture of a corn field rea "Corn yield in 1951 was 11 bushels pe acre." As a former resident of Kansas where the yield per acre of corn would be considerably larger than 11 for such an excellent crop as that pictured, I am puzzled at the extremely small yield at the Agricultural Experiment Station in South Dakota!

M. A. BOHNERT,
Arlington, Va.

The figure should have been 111 instead of 11. We regret the error. Ed.

Sand Dune Control

HOW VOLGA GIANT WILDRYE IS USED TO STEM DUNE MOVEMENT IN THE COLUMBIA BASIN

by DELBERT D. SUGGS, Agriculturist, Columbia Basin Project, Region 1

In the Columbia Basin project more than 10 square miles of sand dunes are moving across a 3½-mile front toward irrigated lands, waterways and reservoirs. Oldtimers say the dunes have moved half a mile in 30 years. Since land classification by the Bureau of Reclamation in 1937 and actual dune measurement beginning in 1947, reliable records show dune movements to have been 3 to 10 feet per year. In one instance, 1 dune moved 88 feet during the 6 months' measurement interval, indicating that the rate of movement can vary greatly.

From Dr. H. A. Hafenrichter, senior agronomist and chief of nursery section of the Portland office of the Soil Conservation Service, it was learned that a large species of wildrye grass might do the job of arresting the dune movement. Volga giant wildrye (*Elymus giganteus*), a tall, drought resistant importation from Siberia had shown good survival characteristics under conditions similar to those of the Columbia Basin. The grass had to fulfill a rigid set of requirements if it was to provide some mechanical resistance to sand movement near the dune surface, stay alive during the dry summers, and be able to survive possible −20° F. winters.

Plants of Volga wildrye were obtained through informal arrangements with the Soil Conservation Service. After the first year's increase of planting stock on the Moses Lake Development farm, a cooperative agreement was entered into between the Bureau of Reclamation and the Soil Conservation Service. In the agreement the Bureau, through the operator of the development farm, was to produce and process the grass, deliver it to the Service and retain as much as 25 percent of the crop. The Service agreed to furnish foundation stock to produce 3 million culms, furnish technical assistance, and repay the cost of production up to $5 per thousand culms.

With the assistance of John L. Schwendiman, head of the Pullman nursery of the Soil Conservation Service, the cultural practices outlined below became standardized during the 1948–53 period in which Volga wildrye has been grown in the Columbia Basin.

After harvest, plants were cleaned of loose sheaths and long roots and were topped to a uniform length of approximately 16 inches. Soon after processing, the plants were heeled in damp sand or planted. Harvest dates usually were October 20 to November 10, so planting was done as soon as practical and before ground became frozen. Dry storage was possible for weeks at temperatures above 60° F., but damp storage required lower temperature (40° to 45° F.) to avoid heating and consequent decay of the bundled culms. In the field the culms were placed in rows 36 inches apart, 16 inches apart in the rows, requiring approximately 10,000 plants per acre. Best survival was obtained when culms were set upright at least 8 inches deep and well compacted around the crown, where most, but not all of the no longer viable roots had been removed. At the time of planting, 60 to 90 pounds of elemental nitrogen, such as ammonium nitrate or sulfate, was applied in the row. The lighter application was made on dryland dune plantings. Irrigated plantings received 30 to 60 additional pounds during the growing season. Because Russian thistle growth in the row of the irrigated grass made harvest difficult, the weed was killed with 2,4-D or removed by hand.

Special equipment was developed to handle the new crop. A two-row celery planter was modified to provide more traction on dunes, to permit deeper planting and give better compaction around the plants. For harvesting the crop a one-row potato digger was adjusted for the tall grass and provided with double rolling coulters to cut the long fibrous roots which interlaced through the soil surface. After the grass was dug,

excess soil was shaken loose. The large bunches of grass were hauled to a shed where roots were trimmed and excess tops were removed with a butcher's cleaver. Separation of the clumps, cleaning roots, and sheaths from culms and sorting for size and sound plants was done by hand. After being tied into bundles, the culms were ready for storage or planting.

Dune plantings were begun after the 1949 harvest. During the next 3 years, 2 dunes, totaling approximately 16 acres, were planted. Survival was poor on the 6-acre dune, good on the 10-acre dune. Shallow and poor placement of plants apparently accounted for the poor stand. It is believed that deep planting and compacted soil around the roots afford best chances of survival.

Replanted areas have little chance of survival after blowouts have begun. Continued scouring results in channeling and eventually a hummocky dune surface. Replacement of a few plants scattered over the area was successful if the profile of the dune was not appreciably altered by the scouring of bare areas.

Damage to Volga wildrye by livestock grazing was negligible. The grass is not palatable to live-

Left: Site of Volga giant wildrye planting on 2 sand dunes (at center of photo). Undisturbed dune is seen in left of photo. Lower left: Volga giant wildrye growing on Winchester Development Farm. Above: Planting culms of Volga wildrye on sand dune. Bundles of wildrye, on platform, are broken and placed in metal boxes in front of operators who are feeding transplanting wheels. Top right: Wildrye planted in 1950. Note increase in stand and protection of the dune afforded after 3 years planting. At right: A stand of grass damaged by browsing cattle. *Photos by H. E. Foss and Stan Rasmussen, Region 1.*

stock but when feed becomes short animals do feed on it. Much more damage was done by trampling the tall stalks which are easily bent or broken. Culms do not survive sharp bends. New shoots sent up from the crown will continue terminal growth if grazed lightly, but continued trampling severely reduces the stand. Damage to new plantings by jackrabbits has been observed. Isolated plantings may need protection against the rodents.

As a vegetative cover for sand dunes under Columbia Basin conditions, Volga wildrye is well adapted as to size, vigor, and ability to withstand both scouring and deposition, and may become widely used under these conditions, provided (1) a good stand is maintained over the whole dune, (2) no blowouts are allowed to form, (3) rabbits do not acquire a taste for the newly planted grass, and (4) the expense of establishing the stand is commensurate with the need for stopping dune movement.

At 1953 prices the cost of planting an acre of Volga wildrye is estimated as—

10,000 culms at $9 per thousand	$90
Planting—6 laborers, 4 hours each at $1.75 per hour	42
Crawler tractor and operator—4 hours at $10 per hour	40
Fertilizer	6–10
Miscellaneous expense such as fuel, transportation, etc	8
Total	190

At present the only known source of supply of Volga wildrye is from the limited production on the Winchester development farm also on the Columbia Basin project, or from the original stock at the soil Conservation Service nursery at Pullman, Wash. It would also be possible to grow the wildrye grass for increase near the place of intended use in order to save hauling costs.

Continued on next page

Costs of local production of planting stock may be estimated from the following data taken from 1953 costs on the Winchester Development Farm.

	Hours per 1,000 culms	Rate per hour	Cost per 1,000 culms yield
Planting, fertilizing, irrigation, etc. (including labor, materials, and water)			$1.30
Digging and cleaning for sorting	0.85	$1.50	1.26
Sorting	2.12	1.00	2.12
Supervision of sorting	.18	1.75	.32

Of course, the final effectiveness of the Volga giant wildrye grass for dune stabilization cannot be determined until a full stand has been maintained for 3 or 4 years. However, the results to date are certainly encouraging and give promise of protecting the farms on which these shifting sands would have slowly but surely encroached.

# # #

Agricultural to Residential

Continued from page 32

residential property. To illustrate how this works out, let's take an example. An average city lot containing $^{16}/_{100}$ of an acre has an allotment of about $^{6}/_{10}$ acre-feet. So the charge for an entire season's irrigation water supply for such a lot last year amounted to about $6.10. This is the easiest money for the district to collect. The highest assessed lands are the ones on which there are the fewest tax delinquencies. As a matter of fact, up to now tax delinquencies have been a negligible item in the financial history of the district.

In addition to serving hundreds of residential properties, the district also furnishes irrigation water to the grounds of the following institutions: one golf course, 2 cemeteries, 2 large Government housing projects, 4 churches, and 6 schools, in addition to the new campus of Weber College. Four new schoolhouses were constructed within the boundaries of the district since the completion of the distribution system.

The following-named directors constitute the present board of directors: George D. Cardon, Richard J. Kingston, and Clyde A. Lindquist. Attorney David K. Holther is district counsel.

Water delivered under the Ogden River project (of which the district is a unit) is known as Pine View water after the Pine View reservoir in Ogden Canyon which is the source of the water supply.

Pine View water has become so popular that hundreds of owners of lands lying just outside of the district are also clamoring to have their lands added to the district. Real estate agents listing properties for sale within the district never fail to mention the irrigation water supply, and prospective purchasers of real estate always ask the question familiar in this area, "Does it have Pine View water?"

# # #

TENTH INSTALLMENT PAID ON PINE VIEW SYSTEM

As this issue went to press, we were advised that Mr. Arlie S. Campbell, secretary of the South Ogden Conservation District, gave to Clinton D. Woods, acting area engineer for the Bureau of Reclamation, a check for $14,981.03, representing the annual installment due the Government for the pipeline system and reservoirs. This was the 10th annual installment received from the District.

Settlement Opportunities on Reclamation Projects Announced

A total of 72 farm units consisting of 9,831 acres on 2 Bureau of Reclamation projects will be opened for sale in June.

These consist of 54 farms on the Wellton-Mohawk Division of the Gila project in Arizona, and 18 farms on the Angostura project in South Dakota. The Wellton-Mohawk farms will be sold by the Bureau of Reclamation, and requests for information regarding these units should be sent to the Regional Director, Bureau of Reclamation, Administration Building, Boulder City, Nev.

Requests for information on the Angostura Units should be forwarded to the Soil Conservation Service, Hot Springs, S. Dak., which agency is handling the sales.

When the lands are offered for sale and settlement, a certain filing period will be established, after which a drawing will be held. This drawing will determine the priority in the selection of farm units available for purchase. Qualified veterans have preference in all instances.

WATER REPORT

OUTLOOK FOR 1954 WATER SUPPLY OF THE WEST

by CLYDE E. HOUSTON and HOMER J. STOCKWELL, Snow Survey Leaders, both of the Soil Conservation Service, United States Department of Agriculture

Prospective water supplies for western United States in 1954 vary from ample supplies and possible floods on the northern section of the Columbia Basin to an extreme water shortage on the Rio Grande in Colorado and New Mexico. This is the latest summary of water supply conditions as prepared by the U. S. Soil Conservation Service, based on observations on nearly 1,200 snow courses in the mountain areas of the West.[1]

This brief analysis of April 1 snow surveys, again presented by the RECLAMATION ERA through the courtesy of the authors, and *MR. R. A. WORK*. head of the Snow Survey Section, shows a wide range of runoff in prospect for irrigation, power generation, and municipal and industrial use.

WATER SHORTAGE CONTINUES

The water shortage of the Rio Grande drainage is particularly critical with a combination of low snow cover and lack of reservoir storage. This situation has developed through a series of years of deficient runoff. Although runoff will be slightly more than during other recent dry years of 1950, 1951, and 1953, total water supply will be less in New Mexico. This pattern of low prospective runoff extends to a lesser extent through to central Colorado, southeastern Utah, and Arizona. Record spring storms during the latter part of March materially improved the outlook for the Salt River in Arizona. Reservoir storage was increased 250,000 acre-feet and soil moisture conditions are good. The storm did not reach the watershed of the Gila River. Previously, record low streamflows were expected.

SNOW SURVEYORS preparing to take samples on established snow course.

COLUMBIA WATERSHED ABOVE NORMAL

The snow cover on the Columbia River Watershed as a whole is heavier than in 1948. However, it is only remotely possible to have a reoccurrence of the late snow melt and spring rains of that year which produced the record flood flows of 1948. Heaviest snowfall has been in northern Idaho, Montana, and southern British Columbia, and on the east slope of the Northern Cascade Mountains. Other sections of this basin, in southern Idaho, northern Nevada, and southeastern Oregon, have been extremely deficient in snowfall during the winter months and summer streamflow will be short. Water supply in most of Oregon will be generally good. Seasonal snow accumulation is normal and 90 percent of last year.

In the following paragraphs the water supply situation is briefly outlined for each State and a table indicating current status of reservoir storage summarizes the outlook for the coming season.

ARIZONA—Water prospects on the Salt-Verde system are fairly good, but the outlook for the Gila-Frisco is poor. Moisture from the storm of March 22–24 did not reach

[1] The Soil Conservation Service is the Federal coordinating agency of snow surveys conducted by its staff and many cooperators, including the Bureau of Reclamation, Forest Service, National Park Service, Geological Survey, various departments of the several western States, irrigation districts, power companies, and others.

The California State Division of Water Resources conducts and coordinates snow surveys in that State, while the British Columbia Department of Lands and Forests, Water Rights Branch, has charge of the snow surveys in that province.

The U. S. Weather Bureau makes West-wide Water Supply forecasts at more than 320 gauging stations, such forecasts being estimated principally on the basis of measurement of precipitation. The Weather Bureau forecasts are for the water year (October–September inclusive), whereas snow survey forecasts are always for the irrigation season only.

into the Gila drainage sufficiently to make up the existing deficiency. This storm was a record for this time of year, exceeding all late storms back to 1905, and resulted in a more optimistic outlook for water on the Salt-Verde area. Prior to the storm all streams were expected to establish record low flows that would probably not have been equalled for many years. Present outlook, entirely due to this storm, is for median conditions on these watersheds.

CALIFORNIA—The California Division of Water Resources reported that the water supply in California will be near or above normal north of the latitude of Oroville, slightly below normal in the remainder of the Central Valley and Southern Lahontan areas and considerably below normal in the Santa Clara Valley and Central Coastal and South Coastal areas, providing normal precipitation occurs during the remainder of the season.

The snow pack averages slightly less than 1 year ago in the Cascade Mountains and the Northern Sierra Nevada and is greater than 1 year ago on the watersheds south of the Stanislaus River. The water content determined by snow course measurements varies from 80 percent of normal on the Yuba, American, and Mokelumne River Watersheds, to an average of about 105 percent of normal on the Upper Sacramento and Tule River Watersheds. Normal or above normal snowmelt runoff is expected in streams of the north coastal area and in the upper Sacramento River in the Central Valley area. In the remainder of the Central Valley area, snowmelt runoff may be expected to vary between 92 and 72 percent of the 50-year normal in the Feather and the American Rivers, respectively.

Storage in California reservoirs utilized for conservation is above normal for April 1 except in the south coastal area. With normal conditions, such reservoirs on streams tributary to the Central Valley area may be expected to fill during the snowmelt period.

COLORADO—Summer discharge of all streams originating in the mountains of Colorado will be less than normal in 1954. Precipitation at high elevations was extremely deficient during the fall months. Season snow accumulation has been below normal. Snow water content on high elevation courses ranged from 70 percent of normal to near normal as of April 1. All medium and low elevation courses were less than 75 percent of normal. Summer runoff on the Rio Grande, Colorado, and Arkansas Rivers and their major tributaries is expected to be in the range of 60 to 70 percent of normal. Some South Platte tributaries, the North Platte, and Laramie Rivers will have slightly higher summer runoff.

IDAHO—Northern Idaho rivers have a record snow pack with excellent water supplies forecast for 1954. Serious flood potentials exist on the Kootenai, Clearwater, Spokane, and Pend Oreille Rivers. The most vulnerable flood plains are along the Kootenai River which has the greatest snow pack ever recorded since snow surveys began on the watershed in 1937. With normal spring conditions this river is expected to peak at 100,000 cubic feet per second as measured near Leonia, Idaho. Serious flood damage can result when the river goes over 90,000 cubic feet per second.

In Southern Idaho, prospective water supplies are poor as a result of a light snow pack. Prospects for the southern tributaries to the Snake River vary from 22 percent to 41 percent below normal.

KANSAS—The water supply outlook for irrigated areas along the Arkansas River is poor as of this date. Irrigation in this area depends on a small part of the normal flow of the river, return flow from irrigation in Colorado and storage in John Martin Reservoir. Inflow to John Martin Reservoir will probably be less than one-half of average unless there are extremely heavy storms on the plains of eastern Colorado during the spring and summer. The reservoir is now nearly empty and storage is only a fraction of normal.

MONTANA—The 1954 snow pack over the Columbia River Basin in Montana is exceptionally heavy this season. The Kootenai River Basin has a record snow pack and a flood potential exists. On the Flathead Basin the snow pack is 20 percent greater than in 1953. The South Fork of the Flathead should flow 2,710,000 acre-feet of water from April through September, or 120 percent average. The Flathead at Polson should reach 8,747,000 acre-feet for the April–September period or 125 percent average. The Clark Fork River above Missoula is short of snow cover this season and is expected to flow 90 percent average. The Bitterroot River has a fair snow pack and is anticipated to flow 107 percent average this season.

The Upper Missouri Basin in Montana has an average snow cover except for the Marias, Teton, and Sun Rivers. These streams reflect the Columbia Basin conditions with a snow pack much higher than last season and 174, 163, and 132 percent of the 6- to 15-year average respectively. A flood potential on these streams could be realized under adverse precipitation and temperature conditions early in the runoff season.

The Yellowstone River Basin through Montana has approximately a 115 percent average snow pack which should produce a fair water supply from April through September. The Clark Fork of the Yellowstone has below normal snow cover and is expected to flow approximately 82 percent average from April through September.

NEBRASKA—Storage in Nebraska reservoirs is above normal. However, in the western area of the State, along the North Platte, this year's water supply is stored in Wyoming or is in prospective streamflow from Colorado and Wyoming. The combination of storage and expected inflow into North Platte reservoirs should be adequate on the North Platte Project for an average irrigation water demand. Current storage will provide sufficient water for the Central Nebraska irrigated district and for the limited irrigation development along the Republican River.

Soil moisture conditions are fair in Nebraska and streamflow is now slightly below normal.

NEVADA—Nevada's outlook for 1954 water supplies from snowmelt is spotty. Snow stored water throughout the State ranges from very poor in the north to fair in the central section and excellent in the southern section. Along the Humboldt tributaries, streams can be expected to flow from 40 to 80 percent normal while the main stem will flow about 50 percent normal. Runoff into Nevada from the East Central Sierra will range from 75 percent in the north to 85 percent normal in the south.

Users of snow fed streams in the southern desert section of the State can expect as high as 150 percent normal flow. October through March streamflow at key stations on the Humboldt and Eeastern Sierra was 90 and 100 percent normal respectively. In general, groundwater levels are below normal.

April 1 reservoir storage in 7 important reservoirs was 79 percent of capacity and 115 percent of the past 10-year average.

NEW MEXICO—The water supply outlook for New Mexico is possibly the worst in recent years. Streamflow is expected to be slightly higher in the Rio Grande than for the years 1950, 1951, and 1953. However, storage in irrigation reservoirs is extremely low. Total reservoir storage and expected streamflow combined will equal less than one-half of the normal irrigation water demand. Pumping will be used to help alleviate the shortage in the Mesilla Valley.

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"PAY AS YOU GO" LAND LEVELING

by RAY O. PETERSON, Settlement Specialist, Bureau of Reclamation, Bismarck, N. Dak.

"Pay as you go" land development will be important and is likely to dominate in areas where there will be a transition from dryland farming to an irrigation agriculture. This shift of farming will take place on nearly all of the lands to be irrigated in the Missouri River Basin. This has been well demonstrated as a sound financial approach in preparing land for irrigation on the Ray Gress farm near Dickinson, N. Dak. The father and son, Ray, Jr., own irrigable land to be served by the Dickinson Reservoir built by the Bureau of Reclamation. Previous to that time, the erratic stream flow of the Heart River did not provide a dependable water supply, and irrigation was therefore, an unknown in the area.

Gress and his son visited the Mandan development farm and were quick to see the potentials of crop production under irrigation. They also realized that bringing irrigation water to the land requires a rather large investment whether gravity

EXAMINING ALFALFA—(left to right) D. J. McLellan, North Dakota Agricultural College, Ray Gress, Jr., and Ray O. Peterson, Bureau of Reclamation. *Photo courtesy of the Bismarck Tribune*

or sprinkler irrigation is used. The Gresses decided to study both methods of applying water and use the one most adaptable to the land they were considering for irrigation. In the meantime, several neighboring farmers had bought sprinkler systems. In order to get sound advice on this problem, the Gresses consulted the North Dakota Agricultural College Extension Service. The Water-Use Agent for the College went over the area and after careful study he decided that the land classed as irrigable by the Bureau of Reclamation on this farm could be irrigated cheaper by gravity method when both the original investment and the annual cost of operation were considered.

The Soil Conservation Service was called on and a complete gravity system was laid out for land to be irrigated. A pump for the 70 acres classed as irrigable was installed. Mr. Gress and his son decided that an 18-acre tract would be about all they could afford to level the first year, and it would be enough to give this type of irrigation a trial. The leveling was done in the fall of 1951 and in the spring of 1952 alfalfa was planted with oats as a companion crop. The spring was very dry and some delay was encountered in getting the pump installed. Water was not put on the field until late in May, yet 2 cuttings of hay, yielding 3 tons per acre, were harvested from the area. Hay, which was very scarce this past year is important to the Gresses in wintering ewe lambs. Ray Gress, Sr., said that the additional alfalfa hay they purchased cost them $25 per ton. This was a bargain since many livestock men in the area paid $35 per ton.

Because there were no equipment operators in the area with experience in leveling land, the cost of leveling the tract was higher than normal for this class of land. It cost $80 per acre to level this 18-acre field. However, the value of the 3 tons of hay secured in 1952 nearly equaled the cost of leveling the land, or looking at it as Ray Gress, Jr., put it—"the hay more than paid for leveling another 20 acres which was developed in the fall of 1952." In the meantime, their land left under dry farming continued to produce the same as nearby farms.

The second field, although at least as difficult to level as the first, cost only $45 per acre to put it in shape for irrigation. The lower cost resulted from a more experienced operator and the Gresses had learned considerable in how to get the work done more efficiently. Under full production, these 2 fields of alfalfa should yield around 5 tons per acre of forage, and will go a long way to assuring an adequate supply of the alfalfa hay needed for the ewe lamb wintering operation system. Last year the shortage of hay made it necessary for the Gresses to purchase 125 tons of alfalfa hay and to cut and bale green Russian thistle. Russian thistle was about the only feed available for livestock during the 1930's, and many farmers were forced to resort to this type of feed in the drought last year.

At top—Irrigation water discharging into field ditch through division box. Immediately above—Division box, field ditch and border dikes on Gress field. ***Top photo courtesy Bismarck Tribune—lower photo by the author.***

Ray Gress, Jr., who does the irrigating, feels that a good job of leveling and laying out of the ditches has been a wise investment. These features make it easy to handle the water and only a small amount of time is required to do the irrigating. He states that it takes only a few minutes to start the siphon tubes going. The water spreads evenly and he can leave the field and do other work for several hours before returning to change the water to the next set of borders.

Both father and son agree that they would like to have 100 acres of irrigated feed crops for their livestock operations. # # #

HOW NITROGEN AND STAND AFFECT CORN PRODUCTION

by DR. H. F. RHOADES, Professor of Soils, College of Agriculture, University of Nebraska

Development farms are playing an important role in demonstrating to the new irrigators the steps involved in converting from dryland to irrigation farming in the Republican Valley of Nebraska. These farms have also been useful for conducting experiments to study the relationships of varieties, hybrids, stand, fertilizer practice, and irrigation practice to crop production in the area. Some of the information obtained on the development farms and other farms in the Republican Valley will be used for discussing the importance of stand and fertilization practice for the production of irrigated corn.

Stand and Corn Production

What should be the stand of corn on irrigated land to make the most efficient use of irrigation water? In answering the question, consideration should be given to the fertility status of the soil and the contemplated use of fertilizers, legumes and manure. For example, a stand of 13,000 plants per acre produced more corn than a stand of 17,000 plants per acre where no fertilizer was applied (fig. 1A.) Where 40 pounds of nitrogen were applied per acre the yields were essentially the same for the two stands. However, where 80 or 160 pounds of nitrogen were applied per acre there was a decidedly larger yield for the higher plant population.

In another experiment (Figure 1 B), stands of 9,400 and 14,800 plants per acre resulted in similar yields where no fertilizer was applied. Where nitrogen fertilizer was applied, there was an increasing benefit of the thicker stand on corn yields with larger rates of nitrogen fertilizer.

A stand of 11,500 plants per acre was definitely superior to a stand of 8,700 plants per acre in an experiment conducted where corn followed alfalfa (fig. 1C). It seems reasonable to assume that the nitrogen level of the soil after alfalfa was adequate to obtain even larger yields with a thicker stand than 11,500 plants per acre.

On the basis of results reported here, it seems reasonable to assume that irrigation farmers in the Republican Valley should attempt to obtain a minimum stand of 13,000 to 14,000 mature plants per acre. Where an adequate supply of nitrogen is made available from that present in the soil and applied in fertilizer, it would be desirable to plan for stands of 17,000 to 19,000 mature plants per acre. Average plant spacings of 9 and 11 inches in 40-inch rows will give plant populations of 17,000 and 14,000 plants per acre, respectively. It will be necessary, however, to set the planter to drop kernels at an average spacing of 8 and 10 inches in 40-inch rows to get stands of 17,000 and

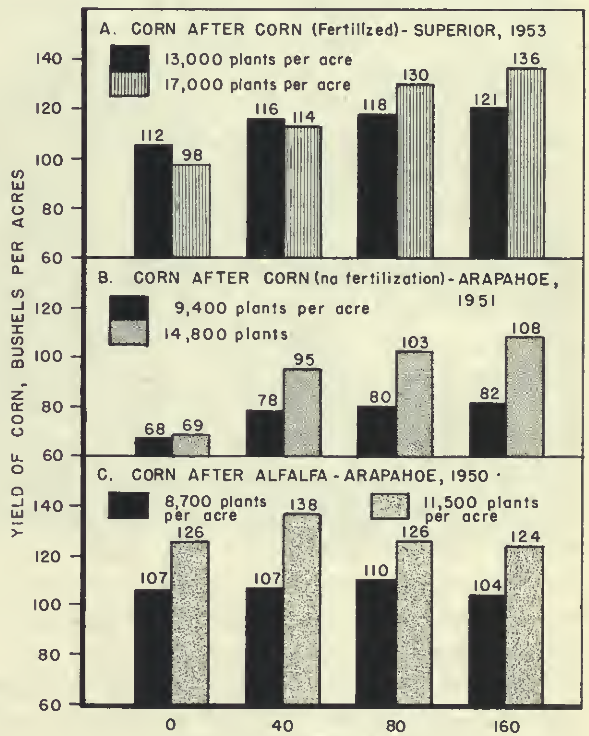

Figure 1

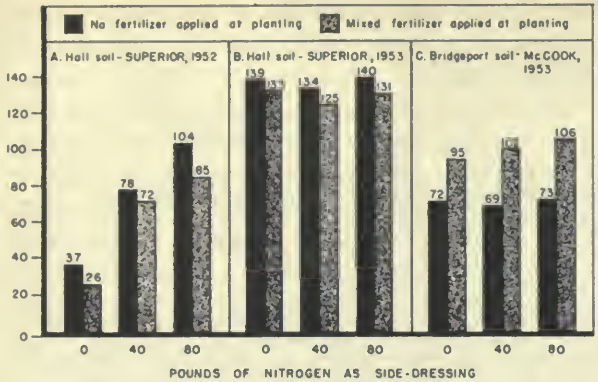

Figure 2

14,000 plants per acre if it is assumed that about 85 percent of the kernels planted produce mature plants.

Nitrogen Fertilizer for Irrigated Corn

Nitrogen is likely to be deficient in the Republican Valley soils for obtaining optimum yields of irrigated corn except where corn follows an excellent stand of legume. How much nitrogen fertilizer should be applied for corn? The answer depends upon the nitrogen status of the soil before applying fertilizer, the supply of other nutrient elements and the stand to be obtained.

Results of experiments conducted in the Republican Valley were summarized to show the general relationship between the productivity of the soil without nitrogen fertilizer to increases in yields of corn due to nitrogen fertilizer for different plant populations (table 1). These results show that for a given stand of corn, the return obtained from the use of nitrogen fertilizer increased whereas the yield of corn without nitrogen fertilizer decreased. With a stand of 11,500 to 14,800 plants per acre, no increase in yield of corn due to nitrogen fertilizer was obtained where the yield was 126 bushels per acre without nitrogen fertilizer. However, when the yield was only 69 bushels per acre without nitrogen fertilizer, a maximum increase of 39 bushels per acre due to nitrogen fertilizer was obtained with a net return of $39 per acre for an application of 80 pounds of nitrogen.

With an increase in plant population from approximately 9,000 to 17,000 plants per acre, there was a definite increase in the potential production of irrigated corn accompanied by a greater return from the use of nitrogen fertilizer (table 1). For example, a maximum increase of 7 bushels per acre due to nitrogen fertilizer was obtained where a stand of approximately 9,000 plants produced 95 bushels of corn per acre without nitrogen fertilizer. In contrast, a maximum increase of 38 bushels per acre was obtained where a stand of approximately 17,000 plants produced 98 bushels of corn per acre without nitrogen fertilizer.

TABLE 1.—*Influence of initial soil productivity and stand on the response of irrigated corn in the Republican Valley to nitrogen fertilizer*

Yield without nitrogen fertilizer, bu. per acre	Increase in yield due to nitrogen fertilizer, bushels per acre		Recommended rate of nitrogen based on increases, pounds per acre	Net return per acre from recommended rate of nitrogen [1]
	From 40 lbs. nitrogen per acre	Maximum increase		
	8,700 to 9,800 plants per acre—Plants 18 to 15 inches apart in 40-inch rows			
107	None	None	None	----------------
95	7	7	40	$4.50
68	10	14	40	9.00
	11,500 to 14,800 plants per acre—Plants 13.7 to 10.6 inches apart in 40-inch rows			
126	None	None	None	----------------
112	4	6	None	----------------
69	26	39	80	39.00
35	38	54	80	66.50
	15,700 to 17,700 plants per acre—Plants 10.0 to 8.8 inches apart in 40-inch rows			
139	None	None	None	----------------
98	16	38	80	45.00
23	47	102	140	132.00

[1] Assumed cost of fertilizer to be 15 cents per pound of nitrogen. Value of corn assumed to be $1.50 per bushel.

Is phosphorus likely to be more deficient than nitrogen in Republican Valley soils for the production of irrigated corn? In general, little benefit can be expected from the use of a mixed fertilizer containing phosphorus at planting time on silty soils similar to Hall and Tripp series. In fact, the fertilizer applied at planting may result in a reduction in yield (fig. 2A and B). There are, however, some soils that are more deficient in phosphorus than nitrogen for corn production. That is illustrated by the results obtained on Bridgeport soil near McCook, Nebr., in 1953 (fig. 2C). A soil test should be made to determine the need of phosphate for corn production. The county agricultural agent can give information on soil testing.

How Nitrogen Affects Corn

Continued from page 44

It should be pointed out that the results obtained from the use of nitrogen fertilizer will be materially influenced by the irrigation practice for corn as well as by stand. Some of the key points that should be considered in irrigating corn are:

1. Prepare the land so that a uniform distribution of water may be obtained.
2. Have the soil filled with water to a depth of 5 or 6 feet by planting time for corn.
3. Select a stream size and length of run to give uniform irrigation without causing erosion or excessive runoff.
4. Give special attention to maintaining a high soil moisture level during the period of corn development just before tasseling through silking.
5. Add sufficient water at each irrigation to fill the soil to field capacity throughout the root zone.

If the irrigation practice is satisfactory as judged from the above points, and a mixed fertilizer containing phosphorus is applied where needed, table 1 should serve reasonably well as a guide for determining the recommended rate of nitrogen fertilizer for irrigated corn in the Republican Valley. # # #

NRA DIRECTORS DISCUSS RECLAMATION

Members of the Board of Directors, National Reclamation Association met with members of the Interior Department Secretariat' and the Commissioner of Reclamation, at the Interior Department on January 27, 1954, to discuss the Western Reclamation Program. Front row (seated left to right): Clarence Davis, Solicitor; C. Petrus Peterson, President, N. R. A.; Douglas McKay, Secretary of Interior; Ralph A. Tudor, Under Secretary of Interior; Wilbur A. Dexheimer, Commissioner of Reclamation; H. L. Buck, Montana. Back row (standing left to right): LaSelle E. Coles, Oregon; Arthur Svendby, South Dakota; Ronald I. Cross, Santa Fe Railway Co., Railroad Representative; J. H. Moeur, Arizona; Fred E. Wilson, New Mexico; Hugh A. Shamberger, Nevada; Earl T. Bower, Wyoming; N. V. Sharp, Idaho; Harry E. Polk, North Dakota; Guy C. Jackson, Jr., Texas; D. D. Harris, Utah; Charles L. Kaupke, California; Harold H. Christy, Colorado; E. R. Wells, Washington.

Water Stored in Reclamation Reservoirs

Location	Project	Reservoir	Storage (in acre-feet)		
			Active capacity[1]	Mar. 31, 1953	Mar. 31, 1954
Region 1	Baker	Thief Valley	17,400	(2)	17,400
	Bitter Root	Lake Como	34,800	5,600	5,800
	Boise	Anderson Ranch	464,200	255,100	257,300
		Arrowrock	286,500	231,200	221,300
		Cascade	650,000	98,800	113,700
		Deadwood	161,900	68,600	89,900
		Lake Lowell	169,000	162,000	158,900
	Burnt River	Unity	24,600	15,100	15,600
	Columbia Basin	F. D. Roosevelt	5,220,000	2,183,000	2,933,000
		Equalizing	1,001,000	243,500	230,700
		Potholes	350,000	47,800	98,000
	Deschutes	Crane Prairie	50,000	50,000	54,000
		Wickiup	182,000	199,000	199,000
	Hungry Horse	Hungry Horse	2,980,000	675,000	1,500,300
	Minidoka	American Falls	1,700,000	1,658,200	1,697,800
		Jackson Lake	847,000	441,900	401,400
		Lake Walcott	95,200	93,200	98,100
		Grassy Lake	15,200	12,800	13,000
		Island Park	127,300	102,500	132,700
	Ochoco	Ochoco	47,500	(2)	47,000
	Okanogan	Conconully	13,200	8,300	8,900
		Salmon Lake	10,500	9,700	9,800
	Owyhee	Owyhee	715,000	574,400	532,000
	Umatilla	Cold Springs	50,000	44,200	50,000
		McKay	73,800	65,300	43,900
	Vale	Agency Valley	60,000	46,600	38,800
		Warm Springs	191,000	165,000	139,900
	Yakima	Bumping Lake	33,800	14,700	13,600
		Cle Elum	435,700	240,100	256,800
		Kachess	239,000	170,500	183,100
		Keechelus	153,000	121,500	82,600
		Tieton	197,000	133,200	122,100
Region 2	Central Valley	Keswick	23,800	0	18,200
		Millerton Lake	500,000	292,900	296,000
		Shasta	4,366,800	3,621,800	3,690,500
	Klamath	Clear Lake	513,300	280,600	319,800
		Gerber	94,300	77,100	73,100
		Upper Klamath Lake	524,800	443,900	433,400
	Orland	East Park	50,600	50,400	50,300
		Stony Gorge	50,000	51,600	50,600
Region 3	Boulder Canyon	Lake Mead	27,207,000	17,764,000	15,701,000
	Davis Dam	Lake Mohave	1,809,800	1,639,000	1,784,600
	Parker Dam Power	Havasu	688,000	618,500	635,800
	Salt River	Bartlett	179,500	48,000	84,700
		Horse Mesa	245,000	236,000	244,800
		Horseshoe	144,000	1,000	76,500
		Mormon Flat	57,800	52,000	54,500
		Roosevelt	1,381,600	1,049,000	693,500
		Stewart Mountain	69,800	51,000	58,600
Region 4	Fruit Growers	Fruit Growers	4,500	4,600	3,000
	Humbolt	Rye Patch	179,000	150,000	95,900
	Hyrum	Hyrum	15,300	15,700	13,800
	Mancos	Jackson Gulch	9,800	3,900	3,200
	Moon Lake	Midview	5,800	5,000	5,800
		Moon Lake	35,800	21,100	13,500
	Newlands	Lahontan	290,900	273,200	270,500
		Lake Tahoe	732,000	552,000	582,000
	Newton	Newton	5,400	5,300	3,200
	Ogden River	Pine View	44,200	19,500	8,000
	Pine River	Vallecito	126,300	56,300	36,300
	Provo River	Deer Creek	149,700	116,700	100,400
	Scofield	Scofield	65,800	50,400	34,800
	Strawberry Valley	Strawberry	270,000	249,800	220,200
	Truckee River Storage	Boca	40,900	6,200	6,500
	Uncompahgre	Taylor Park	106,200	64,100	52,500
	Weber River	Echo	73,900	46,800	36,900
Region 5	W. C. Austin	Altus	145,000	17,600	15,500
	Balmorhea	Lower Parks	5,900	5,500	6,100
	Carlsbad	Alamogordo	131,900	32,000	34,000
		Avalon	6,600	3,600	4,800
		McMillan	38,700	200	0
	Colorado River	Marshall Ford	810,500	800,600	669,400
	Rio Grande	Caballo	345,900	137,000	28,600
		Elephant Butte	2,197,600	277,700	138,600
	San Luis Valley	Platoro	60,000	0	0
	Tucumcari	Conchas	269,100	74,600	66,700
Region 6	Missouri River Basin	Angostura	92,000	50,600	32,700
		Boysen	560,000	495,000	382,000
		Canyon Ferry	1,615,000	0	413,700
		Dickinson	15,400	4,400	5,700
		Heart Butte	68,700	62,400	56,200
		Keyhole	330,300	13,800	8,600
		Shadehill	300,000	84,200	82,700
	Belle Fourche	Belle Fourche	185,200	65,600	120,400
	Fort Peck	Fort Peck	11,400,000	8,173,300	7,605,800
	Milk River	Fresno	127,200	85,900	86,100
		Nelson	68,800	29,700	38,100
		Sherburne Lakes	66,100	18,900	(2)
	Rapid Valley	Deerfield	15,100	13,900	15,100
	Riverton	Bull Lake	155,000	56,000	69,300
		Pilot Butte	31,600	23,500	17,700
	Shoshone	Buffalo Bill	394,600	154,800	147,800

[1] Available for irrigation.

[2] Not reported.

Water Stored in Reclamation Reservoirs—Continued

Location	Project	Reservoir	Storage (in acre-feet)		
			Active capacity[1]	Mar. 31, 1953	Mar. 31, 1954
	Sun River	Gibson	105,000	58,400	77,500
		Pishkun	30,100	17,500	20,500
		Willow Creek	32,400	21,400	26,900
Region 7	Colorado-Big Tompson	Granby	467,600	350,400	298,700
		Green Mountain	146,900	78,500	47,100
		Horsetooth	151,700	116,200	114,000
		Shadow Mountain	1,800	1,500	1,600
	Missouri River Basin	Bonny	(2)	28,900	39,900
		Cedar Bluff	131,700	69,700	56,400
		Enders	36,000	25,700	33,700
		Harry Strunk Lake	35,000	32,600	29,100
	Kendrick	Alcova	190,300	155,400	21,300
		Seminoe	993,200	546,900	180,700
	Mirage Flats	Box Butte	30,600	22,400	18,100
	North Platte	Guernsey	44,200	30,600	19,300
		Lake Alice	11,400	2,700	8,600
		Lake Minatare	60,800	22,000	31,200
		Pathfinder	1,040,500	867,400	866,200

[1] Available for irrigation. [2] Not reported.

WATER REPORT—Continued

Precipitation in valley areas has been negligible and soils are extremely dry. Similar conditions exist along the Pecos except that reservoir storage is slightly better than for the Rio Grande. Soils in the Carlsbad and Roswell districts are extremely dry.

NORTH DAKOTA—The High Plains State of North Dakota did not receive a snow cover of any great extent this season. The ground for the most part was not frozen and what snow did fall melted into the soil without causing flood damage. Soil conditions are relatively dry and spring rains will be necessary to assure sufficient moisture for crop growth.

OKLAHOMA—The W. C. Austin Irrigation Project in Oklahoma has a very limited water supply. Storage in Altus Reservoir is about 16,000 acre-feet, which is 25 percent of average and 12 percent of capacity. This reservoir is entirely dependent on flood runoff. Storage has been gradually declining for 3 years. Precipitation has been deficient for several months. Soils in the irrigated area are dry.

OREGON—Water supply outlook for 1954 in Oregon is fair to excellent. Near average streamflow is expected except in the far eastern portion of the State. Water supplies will be adequate in western Oregon and in all areas where storage water is available. Some eastern Oregon lands will have late season shortages unless adequate May–June rains are received.

Water content of mountain snow cover averages 102 percent of normal based on 106 long record snow courses and is 89 percent of last year. Reservoired water in 23 reporting reservoirs is 116 percent of average. Mountain soils are well wetted except in the extreme eastern part of the State.

SOUTH DAKOTA—Available records of reservoir storage in South Dakota show less than normal reservoir storage. However, the snow cover is apparently well above normal in the Black Hills, indicating a normal yield for this watershed.

TEXAS—Irrigation water will be extremely short in the El Paso area of west Texas, which depends primarily on storage in Elephant Butte Reservoir. This area has been short of water for several years and this year there will probably be less total water available from the Rio Grande than for any year of record.

UTAH—There are two small areas in the State which have very poor runoff prospects. The Farmington-Bountiful area of the Central Wasatch Front in northern Utah has the poorest snow cover since the drought year of 1934. In southern Utah on the East Fork Sevier River-Escalante River, in spite of the heavy snow accumulation of March, snow cover is still only 50 percent of average, although about one-third more than last year. Elsewhere in the State, runoff prospects vary from 60 to 134 percent of average.

Water users having river storage rights will in general have sufficient water for their needs during the coming summer. Water users having only natural flow rights in those sections of the State other than southwestern Utah and the Uinta Basin, can anticipate below average late season water supplies, unless a very cold, wet spring develops.

Holdover storage in fourteen reporting reservoirs is 66 percent of capacity. This compares with 54 percent of capacity for the period 1942–1951.

WASHINGTON—The Chelan River in Washington has the greatest snow pack measured in the 24 years that the snow course network has been in operation. This snow pack is 62 percent above normal. Other rivers in Washington also have a very heavy snow pack and water supply prospects are excellent throughout the State.

A flood potential exists on the main stem of the Columbia River as measured near The Dalles, Oregon. This major river also has a record snow pack that is expected to produce an unregulated peak of 760,000 cubic feet per second. Unusually heavy spring rains and a late snowmelt could raise this peak to a serious magnitude.

WYOMING—The snow cover throughout the State of Wyoming ranges from above normal in the Snake River Basin, Wind River Basin, Big Horn and Yellowstone Park Watersheds to 80 percent of normal in the North Platte, Laramie River, and Pole Mountain drainage areas. This is the second year in succession that the southern part of the State has experienced a subnormal snow pack and the seriousness is now increased by the reduced storage in the North Platte and Laramie River Reservoirs.

MAJOR RECENT CONTRACT AWARDS

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DC-4064	Cachuma, Calif	Jan. 19	Construction of earthwork, steel pipe lines, and structures for laterals 23 to 30, inclusive, Carpinteria pumping plant and Gobernador reservoir, Carpinteria distribution system.	Stolte, Inc., Oakland, Calif	$566,780
DS-4069	Missouri River Basin, N. Dak	Jan. 29	Three 20,000/26,667/33,333-kilovolt-ampere autotransformers with lightning arresters for Jamestown substation.	American Elin Corp., New York, N. Y.	223,830
DS-4073	Palisades, Idaho	Jan. 26	Twelve 7-foot 6-inch by 9-foot outlet gates, including handling equipment, for outlet works at Palisades Dam.	Goslin-Birmingham Mfg. Co., Inc., Birmingham, Ala.	598,490
DS-4078	do	Jan. 21	Two 20-foot by 50-foot radial gates for Palisades Dam	California Steel Products Co., Richmond, Calif.	65,900
DC-4080	Middle Rio Grande, N. Mex	Jan. 8	Construction of earthwork, clearing, and structures for rehabilitation of drains, Unit AE-1.	Slade and Watson Grading Co., Farmington, N. Mex.	79,492
DC-4081	Missouri River Basin, N. Dak	Jan. 21	Construction footings, types "A", "B", "C-1", and "PT", and erecting steel towers for 86.1 miles of Jamestown-Fargo 230-kv transmission line, schedule 1A.	Bay Construction, Inc. and Don L. Cooney, Inc., Seattle, Wash.	610,079
DC-4082	Tucumcari, N. Mex	Jan. 13	Construction of earthwork and structures for drains 2, 6A, 6B, 10, 10A, 20, 50, and 51, Coulter drain and rehabilitation of Ragsdill drain.	Joseph C. Hastings, Albuquerque, N. Mex.	98,042
DS-4086	Missouri River Basin, S. Dak	Mar. 5	Galvanized steel double-circuit towers for Big Bend-Granite Falls 230-kv transmission line.	American Bridge Division, United States Steel Corp., Denver, Colo.	2,626,913
DC-4087	Missouri River Basin, Iowa	Feb. 2	Construction of Sioux City substation	Gustav Hirsch Organization, Inc., Columbus, Ohio.	233,723
DC-4088	Yakima, Wash	Feb. 10	Construction of siphon crossings for Chandler canal, Sta. 285+97 to 291+87.71 and 367+00.02 to 372+40.	Erwen Construction Co., Pasco, Wash.	293,254
DS-4089	Palisades, Idaho	Mar. 4	Four oil-pressure actuator governors for hydraulic turbines for Palisades powerplant.	Woodward Governor Co., Rockford, Ill.	105,540
DC-4096	Middle Rio Grande, N. Mex	Feb. 8	Construction of earthwork, clearing, and structures for rehabilitation of 24 miles of drains, Unit BW-1.	Vega Engineering and Grading Co., Berkeley, Calif.	187,802
DC-4097	do	Feb. 17	Construction of earthwork, clearing, and structures for rehabilitation of 38 miles of drains, Unit BE-1.	Roy Dugger Co., Corpus Christi, Tex.	134,670
DC-4099	Colorado-Big Thompson, Colo	Feb. 9	Construction of St. Vrain supply canal, Sta. 236+80 to 244+18.0 Ah.	Colorado Constructors, Inc., Denver, Colo.	52,240
DS-4100	Central Valley, Calif	Feb. 26	43 vertical-shaft, turbine-type pumping units and 12 vertical-shaft pumping units for D-3, D-9 to D-15, and D-17 to D-19 pumping plants, Unit 3, Delano-Earlimart irrigation district, Friant-Kern canal distribution system, Schedules 1, 2, and 3.	Food Machinery & Chemical Corp., Peerless Pump Division, Los Angeles, Calif.	182,587
DC-4101	do	Mar. 1	Construction of earthwork and structures for lateral 32.2-9.9W extension and lateral 32.2-13.2W, Unit 3, Madera distribution systems, Schedule 1.	H. Earl Parker, Inc., Marysville, Calif.	161,438
DC-4101	do	do	Construction of earthwork and structures for lateral 24.2 extension and lateral 24.2-17.0W, Unit 3, Madera distribution system, Schedule 2.	Morison Construction Co. and Ted Schwartz, Grass Valley, Calif.	235,361
DC-4104	do	Mar. 31	Completion of Folsom powerplant and switchyards	Stolte, Inc., Oakland, Calif	852,517
DC-4109	Davis Dam, Ariz.-Nev	Mar. 29	Installation of cooling systems for generator exciters at Davis powerplant.	Ashton Building Co., Tucson, Ariz.	59,228
DC-4110	Middle Rio Grande, N. Mex	Mar. 16	Construction of earthwork, clearing, and structures for rehabilitation of 26.5 miles of drains, Unit BW-2.	D. W. Falls Construction Co., Tulsa, Okla.	109,511
100C-155	Boise, Idaho	Jan. 5	Construction of earthwork and structures for improvement and extension of Willow Creek wasteway.	Marshall and Haas, Belmont, Calif.	105,070
117C-208	Columbia Basin, Wash	Mar. 2	Moving and remodeling five residences for O & M housing at Babcock pumping plant, Area W-6A, Frenchman Hills tunnel and Lind Coulee wasteway, Schedules 1, 2, 3, and 5.	Cherf Bros., Inc., and Sandkay Contractors, Inc., Ephrata, Wash.	55,300
600C-139	Buford-Trenton, N. Dak	Mar. 23	Construction of earthwork and structures for relocation of Main canal and lateral 3.8, and riprap protection for pumping plant.	L. P. Anderson, Miles City, Mont.	53,418

WORK CURRENTLY SCHEDULED[1]

Project	Description of work or material
Bitter Root, Mont	Rehabilitation work at Lake Como Dam about 15 miles south of Hamilton, Mont.
Boulder Canyon, Nev.	Two 16.5-kilovolt, 5,000-ampere, 2,500-millivolt-amperes interrupting rating, 150-kilovolt impulse level, 8-cycles, power circuit breakers for generator Unit N-8, Hoover Powerplant.
Do	One oil-pressure, cabinet-type actuator governor for regulating speed of one 145,000-horsepower, vertical-shaft hydraulic turbine for Unit N-8, Hoover Powerplant.
Central Valley, Calif.	Constructing 7 miles of 500 cfs earth-lined canal, including 8 culverts, 4 siphons, 8 timber bridges, 2 checks, wasteway structure, canal inlet, and overchute for Corning Canal, First Section, near Red Bluff, Calif.
Do	Constructing about 3½ miles of lateral extension for Lateral 24.2, Madera Distribution System, Unit 3.
Do	Constructing about 45½ miles of 33- to 12-inch concrete pipe line for Units 2 and 3, Exeter Distribution System, near Exeter, California.
Do	Placing about 100 tons of penetration asphalt on Friant-Kern Canal patrol road, near Orange Cove in Fresno and Tulare Counties, California.
Colorado-Big Thompson, Colo.	Constructing about 4 miles of 150 to 200 cubic feet per second capacity earth canal, for Boulder Creek Supply Canal, including siphons, blow-off, parshall flumes, metal pipe flumes, pipe culverts, drops, drainage inlets, turnouts, gaging station shelters, canal fence structures, overflow sections, timber bridges, checks, chute and stilling pool.
Do	Raising Satanka Dike at Horsetooth Reservoir about 4 feet will consist of about 2,000 cubic yards of foundation excavation, 6,000 cubic yards of earthfill, and 3,150 cubic yards of riprap. About 1,350 cubic yards of the riprap must be removed from existing dike for use on enlarged dike. Near Fort Collins, Colo.
Columbia Basin, Wash.	Constructing about 70 miles of laterals, including checks, drops, division boxes, road crossings, 13 relift pumping plants, and other minor structures for Area E-6 Distribution System, near Othello, Wash.
Do	Constructing about 21.5 miles of laterals, sublaterals and drains, Block 86.
Do	Constructing about 1½ miles of unlined earth section for drains, Blocks 41 and 42.

[1] This listing shows bid calls planned through June 1954 and is subject to change.

WORK CURRENTLY SCHEDULED[1]—Continued

Project	Description of work or material
Columbia Basin, Wash.	Constructing about 4 miles of unlined earth section for drains, including road crossings, drops and chutes Blocks 11 and 49, near Othello, Wash.
Davis Dam, Calif.	Installing 161-kilovolt facilities at Blythe Substation near Blythe, Calif., will consist of constructing concrete footings, erecting Government-furnished steel structures, and installing power circuit breakers, switches, and three 161-kilovolt current transformers, all Government-furnished.
Do	Constructing 19,500-kilovolt-ampere capacity Casa Grande Substation. Government will furnish structural steel and major electrical equipment, including one 13.8- to 115-kilovolt, 3-phase, power transformer
Do	Constructing the Oracle Substation will consist of furnishing and erecting steel prefabricated control building and steel structures, and constructing 115-kilovolt switching facilities and installing Government-furnished switching equipment.
Do	Three 60-kilovolt-ampere, single-phase, 346-ampere, dry-type, series reactors; three 15-kilovolt, single-pole, hook-operated, disconnecting switches; three 15-kilovolt lightning arresters; and one 750-kilovolt-ampere, 13.8-kilovolts, plus or minus 10 percent, 3-phase step-voltage regulator for Coolidge Substation.
Eden, Wyo	Constructing West Side Laterals and Sublaterals north and west of Farson, Wyo. The work includes 10 miles of 25 to 120 cubic feet per second laterals, and 3½ miles of 6 to 20 cubic feet per second sublaterals.
Do	Constructing 2.2 miles of unlined and 2.1 miles of earth-lined canal, with capacities of 150 and 190 cubic feet per second for Eden Canal, Second Section; and 5.8 miles of laterals of 6- to 40-cubic feet per second capacities for Lateral E–7 and Lateral E–8. About 40 miles north of Rock Springs, Wyo.
Fort Peck, N. Dak.	Constructing a 30,000-kilovolt-amperes addition to Williston Substation will consist of modifying and adding to existing steel structures and installing Government-furnished equipment including one 30,000/40,000/50,000-kilovolt-amperes, 110- to 69-kilovolt, 3-phase transformer, and 115-kilovolt disconnecting switches.
Do	Constructing 6,000-kilovolt-amperes, 115/69/12.5-kilovolt O'Fallon Creek Substation near Fallon, Mont., will require constructing foundations, furnishing and erecting a small prefabricated-type service building, furnishing and erecting structural steel, and installing electrical equipment major items of which will be furnished by the Government; and furnishing all materials for and constructing about two miles of 3-phase, wood-pole, H-frame 69-kilovolt transmission line.
Gila, Ariz.	Construction of Unit 2 of Wellton Distribution System near Wellton, Ariz., will require constructing about 26 miles of unreinforced concrete-lined laterals; earthwork for Wellton-Mohawk Canal, Station 938 Overchute Channel, and Coyote Wash Wasteway and Flood Channel; and constructing concrete siphons, culverts, turnouts, checks, drops, chute and stilling pool, and lateral turnouts and deliveries.
Kendrick, Wyo	Installing Government furnished supervisory gate control and position indication equipment, water level recording equipment, and telephone facilities at Alcova Dam and Casper Canal headworks, about 30 miles southwest of Casper, Wyo.
Minidoka, Idaho	Constructing 16 distribution substations for Group 2 wells, North Side Pumping Division, near Rupert, Idaho.
Missouri River Basin, Kans.	Constructing 3d Section of Courtland (685 cubic feet per second), Ridge (90 cubic feet per second), and North (50 cubic feet per second) earth canals, and Courtland Laterals, including checks, culverts, wasteways, turnouts, drops, division boxes, siphons, and other minor structures. Near Concordia, Kans.
Do	Constructing section 3A of Courtland Canal and Distribution System, including about 3 miles of 685 cubic feet per second earth canal, lateral turnouts, timber bridges, concrete road crossings, concrete box culvert, precast concrete pipe culverts, and steel pipe overchutes.
Missouri River Basin, Mont.	Painting nine frame houses at Tiber Dam Government Camp.
Do	Bonded floor finish, metal work, and fencing for completion of Canyon Ferry Dam, powerplant and permanent Camp.
Do	One welded plate-steel outlet pipe and one 66-inch steel bulkhead with accessories for river outlet works at Tiber Dam.
Missouri River Basin, Nebr.	Constructing about 5 miles of 12 to 42 cubic feet per second open canal, including 2 pipe culverts, 19 pipe siphons, 6 turnouts, 2 checks, and 2 road crossings for Franklin Canal, fourth Section. Constructing about 29 miles of open laterals for about 7,000 acres, including 6 railroad and 24 other siphons 18 to 30 inches in diameter, 117 turnouts, 18 to 24 inches in diameter, 31 checks, 30 vertical drops, 81 incline drops, two 24-inch culverts, and ten 18-inch corrugated metal pipe culverts, for Franklin Laterals, Second Section. Near Red Cloud, Nebr.
Do	Constructing concrete foundations, furnishing and erecting structural steel, and installing (but not connecting) Government-furnished electrical equipment, including one 30,000-kilovolt-amperes, 13,800-volt, 3-phase, synchronous condenser; one 27,000/36,000-kilovolt-amperes, 115,000/66,400- to 13,200-volt, 3-phase, power transformer; and four 115,000-volt power circuit breakers. Near Gering, Nebr.
Do	Modifying O'Neill Substation, Fort Randall Line Bay, will consist of constructing concrete footings, furnishing and erecting structural steel and installing Government-furnished equipment including 115-kilovolt power circuit breaker, two 115-kilovolt current transformers, and carrier current equipment.
Missouri River Basin, Nebr.-Kans.	Constructing 9.9 miles of earth section for Franklin Canal, third Section, including wasteway channels and drains, turnouts, timber bridges, culverts, checks, operating road crossings, drainage inlets, and 4 gas-line crossings, near Riverton, Nebr.
Missouri River Basin, N. Dak.	Extending Garrison-Voltaire Transmission Line into Garrison Switchyard will consist of constructing and stringing about 2.6 miles of 115-kilovolt, 3-phase, 60-cycle single-circuit steel-tower transmission line with 2 ground wires, on reinforced concrete footings. Government to furnish 4 tension-type towers of about 18,000 pounds each, and 7 suspension-type towers of about 15,000 pounds each, complete with stub angles. Contractor to furnish all other materials. Work includes dismantling an existing steel and wood pole line about 4 miles long.
Do	Constructing a 60- by 120- by 14-foot welded-steel rigid-frame warehouse building with metal walls and roof on the site, and grading and fencing proposed Fargo Substation site.
Do	Drilling six irrigation supply wells south of Jamestown, North Dakota, including installation of casing and screens.
Do	Fabricated galvanized structural steel single circuit towers for the 55-mile 115-kilovolt Garrison-Voltaire Transmission Line.
Missouri River Basin, S. Dak.	Installing supervisory control and telemetering equipment at Watertown, Brookings, Sioux Falls, Huron, Mount Vernon, and Armour Substations.
Do	One 230-kilovolt, manually-gang-operated, air disconnecting switch with automatic high-speed grounding blades; two 230-kilovolt, manually-gang-operated, air disconnecting switches with grounding blades; two 115-kilovolt and three 230-kilovolt, manually-gang-operated, air disconnecting switches for Watertown Substation.
Do	One 230-kilovolt, 1,200 ampere, 5,000-millivolt-amperes interrupting rating, 3-cycle, power circuit breaker for Watertown Substation.
Do	Main control boards and station service boards for Pierre Substation.
Missouri River Basin, Wyo.	Constructing 15,000-kilovolt-amperes Basin Substation will involve furnishing and erecting steel structures and a 20- by 32-foot prefabricated metal control building, and installing Government-furnished equipment including 15,000-kilovolt-amperes, 115- to 34.5-kilovolt, 3-phase transformer; and 115- and 34.5-kilovolt switching equipment. About 30 miles north of Worland, Wyo., near Basin, Wyo.
Do	Constructing Lusk Rural Substation will consist of concrete foundations, erecting Government-furnished structural steel, and installing Government-furnished electrical equipment, including one 5,000-kilovolt-amperes, 3-phase transformer; one 500-kilovolt-amperes, 25,000-volt, 3-phase, automatic step-voltage regulator; and two 23,000-volt, 600-ampere oil circuit breakers.
Do	Furnishing and installing pumping equipment for one to three water supply wells 400 to 500 feet deep near Shoshoni, Wyo. Work may include construction of a small pump house.
Do	Drilling and developing one to three 10-inch water supply wells, 400 to 500 feet deep. Near Shoshoni, Wyo.
Palisades, Idaho	Two 96-inch ring-follower gates and hoists for outlet works at Palisades Dam.
Do	Two 96-inch hollow-jet valves for outlet works at Palisades Dam.
Do	Controls for 96-inch ring-follower and outlet gates at Palisades Dam.
Do	One 12,000- to 480-volt, 3-phase, 60-cycle, double-ended, 1,000-kilovolt-amperes each end, unit substation for Palisades Powerplant.
Palisades, Idaho-Wyo.	Clearing timber and brush from Part 1 of Palisades Reservoir Area. On Snake River near Palisades, Idaho.
Solano, Calif.	Two 54-inch hollow-jet valves for outlet works at Monticello Dam.
Weber Basin, Utah.	Wanship Dam on the Weber River about 25 miles east of Salt Lake City, Utah, will be a zoned earthfill structure 156 feet high and 2,000 feet long. The outlet tunnel will be 12 feet in diameter and about 865 feet long, circular in cross section upstream and horseshoe-shaped downstream from the gate chamber. Concrete construction will include a 75-foot-wide free overflow spillway with chute and stilling basin; and a river level outlet works with a tower-type intake structure, gate chamber, tunnel, control house, stilling basin, and two stilling wells. Government will furnish steel penstock for installation in the tunnel from the gate chamber to the control house, steel pipe for installation from the control house to canals on each side of the river, high pressure gates for installation in the gate chamber and control house, and valves for installation in the control house and at the canal stilling wells.
Do	Constructing about 7.7 miles of 700 cubic feet per second concrete-lined Gateway Canal southeast of Ogden, Utah.
Yakima, Wash.	Hoists for three 7.25- by 7.39-foot and two 10- by 10.66-foot fixed-wheel gates for pumpline and penstock intakes for Chandler Power and Pumping Plant.
Do	Battery chargers, low-voltage distribution boards, lighting transformers and voltage regulator for Chandler Powerplant.

[1] This listing shows bid calls planned through June 1954 and is subject to change.

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IN THIS ISSUE . . .

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Bureau of Reclamation, Washington, D. C.

J. J. McCARTHY, Editor

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* * *

OUR FRONT COVER

Bartlett Dam on the Salt River project in Arizona is the world's highest multiple arch dam. Commissioner of Reclamation W. A. Dexheimer was field engineer on this job during his earlier days with the Bureau. At the time, he wrote the article Construction of the World's Highest Multiple Arch Dam which appeared in the August 1938 issue of the Reclamation Era.

A limited number of reprints of the article are available to interested persons. Copies may be obtained by writing to the Bureau of Reclamation (Code 460), Department of the Interior, Washington 25, D. C.

Coachella Grapes—

Earliest in the Nation

by DEAN D. HALSEY, Farm Advisor
Extension Service, Riverside, Calif.

Among the many changes coming about as a result of the importation of Colorado River water to the Coachella Valley of southern California has been the rapid expansion of the early table grape plantings. Grapes have been an important crop in this desert valley for many years but abundant water has made it possible to utilize many of the lighter soils which were either uneconomical to irrigate with pumps or were in locations where pumped water was difficult to obtain or of poor quality.

The present grape acreage in the valley shows a total of 6,648 bearing acres and about 2,000 nonbearing acres indicating the heavy planting that has been done in the last few years. Yields are cut down in order to assure early maturity so that the average per acre yield for the valley is only about 200 packed 24-pound boxes. These sold in 1953, according to the Riverside County agricultural commissioners' report, for an average of about $3 per box. Prices received vary greatly according to the quality of the fruit but especially as regards the season of maturity. Shipment began last year around the first of June at which time the 24-pound boxes were selling for as high as $13 on the New York market. During the middle of the season when supplies were at the heaviest the price on the same market was only about $4 a box. This has convinced many growers that there are enough midseason grapes in the valley now and that additional plantings should be made only in early locations or of early varieties.

The process of establishing a vineyard on these desert sands begins with first stripping the native desert brush, and leveling the soil to almost flat grades. No precaution is taken to avoid stripping off the surface soil in the leveling operations since in these recently developed lands the subsoil seems to be about as good as that on the surface. Next, the underground concrete pipe is laid for the irrigation system. Usually the irrigation runs are short (preferably not over 330 feet) and the valves are placed 12 feet apart, making one valve for each row of grapes. Any salt accumulations in the soil are removed by leaching

at this time. It is considered highly desirable to establish a cover crop or even to grow alfalfa a year or two to improve the soil, but in their haste to get into production many growers plant the rooted cuttings without extensive soil preparation.

After leaching, the field is marked out for the usual 8- by 12-foot vineyard spacing and rooted cuttings about 15 inches in length are planted. The first year the cuttings are allowed to grow without any attempt to train them, and in this region of very high heat the growth made with good care in one season is phenomenal. In the winter following, the first summer's growth the vines are pruned back to the ground and a redwood stake about 6 feet long is driven in alongside each vine. A wire trellis is strung on these stakes and in the second season one shoot is carefully trained up the stake and out on the wire. At the end of the second season of growth the vines are pruned to the shape preferred for the particular variety so that in the third season of growth a small crop of fruit usually can be picked.

Of course it should not be inferred that there are no difficulties to be surmounted in thus bringing the desert into production. Although the light sandy soils are preferred for early grapes, it is sometimes extremely difficult to get satisfactory growth out of the vines. High winds, especially when growth first starts in the spring, and rabbits, insects and nematodes, which damage the roots, are all obstacles to be overcome. Summer temperatures of 110° to 115° are quite common so that frequent and heavy irrigations are required, especially while the vines are getting their roots down.

When the vines attain a good size they are allowed to set a small crop of fruit at first, then the load is increased in succeeding years to the maximum the vine can carry and still reach early maturity. Just after bloom the vine is "girdled" by removing a ring of bark from the trunk. This causes the sugars manufactured in the leaves to accumulate in the fruit, making the seedless types larger in size and the seeded varieties mature earlier. Thinning is accomplished by cutting out the smaller and less perfect clusters and removing some of the berries from the larger clusters. The result is a highly uniform product of medium sized clusters with large berries and good color.

Harvest begins about the first of May and continues to after the middle of July, at which time the vineyards of the southern end of the San Joaquin Valley begin to produce. At harvest time the fruit may either be picked and placed directly into the boxes in which it is to be sold or picked into field boxes and passed over a sorting belt in a packing house. In either case every effort is made to get the fruit refrigerated quickly to

Continued on page 58

SPEED in picking, hauling, and refrigerating early table grapes is key to high quality (photo below). At right: Sweeter, larger, and earlier grapes are produced by "girdling" or removing a ring of bark from the trunk just after bloom.

A WEED SPRAYER FOR IRRIGATION CANAL BANKS AND DRAINAGE DITCHES

by JOHN P. JEFFERS, Tracy Operations Office, Region 2, Sacramento, Calif.

What kind of equipment does it take to apply weed control chemicals on canal banks and drainage ditches? This was our problem when we were acquiring weed control equipment for some of the canals of the Central Valley project. We could not find commercial weed control equipment suitable for applying herbicides on large spoil banks and steep roadways as well as on small canals, so we designed a weed sprayer that could be operated under these extreme conditions. Several features were included on the sprayer for more efficient operation and to make weed spraying easier.

Our weed sprayer unit is mounted on a 4-wheel drive truck so that it can be used on loose spoil banks or in remote areas where the access roadways are poor. The unit can be constructed on skids without a rear platform and used on a flatbed truck.

The V bottom tank, which has a mechanical agitator, is mounted at a right angle to the truck frame just in back of the truck cab. This arrangement centers the weight on the truck chassis; thus, making a more compact sprayer. The tank is low and wide so that the center of gravity is low making a safer handling rig on slopes. The location of the tank also simplifies the connections of the mechanical agitator to the engine and centrifugal pump. The sprayer tank has a capacity of 350 gallons.

The rear platform provides a place for the sprayer operator, a support for the boom covering the area under the truck as well as the short side booms which are used on small irrigation and drainage ditches.

The flat top of the tank is surrounded by a guard rail. The guard rail provides a safety hand rail for the operator during refilling operations and a place to carry materials. It is also a mounting place for the hose reel and electrical hoist.

A small square tank of approximately 10-gallon capacity is attached to the large tank. The inlet and outlet to the square tank are so arranged that water will always remain in the tank and is available for priming the pump even though the main tank is completely empty.

A gasoline engine powers a four-stage centrif-

ugal pump. Hook-up of the mechanical agitator with the centrifugal pump is simple. A belt from the engine power shaft is connected to a jack shaft attached on the back side of the tank, and a roller chain connects the jack shaft to the agitator. A boat type stuffing box with packing is used on the agitator shaft. The clutch on the jack disengages the mechanical agitator when it is not needed. Easy-operating, leak-proof, ball-type cut-off valves on the pump manifold connect with the rear boom, the side boom, and the hose reel.

Line strainers are provided for the rear and side booms and a large strainer is located on the inlet side of the pump.

The boom mount is built to provide easy adjustment of the "boom height" on ditch bank spray equipment so that bolts are not necessary.

The mount is composed of two units: (1) the "boom base," and (2) the "worm screw adjustment."

The boom base is built so that by removing the horizontal pin and unfastening the hose connection, the long boom is removed from the rig in 60 seconds. By removing the vertical pin, the side boom will swing along the side or parallel with the truck for going around power poles or for passing through narrow gates. The worm screw arrangement with a hand crank adjusts the boom base to proper spray height and for the angle of the slope.

The electric hoist is mounted on the flat top of the tank. A $\frac{3}{16}$-inch cable from the hoist drum passes over a wide roller pulley to the boom.

Controls to the hoist are not in a fixed position. They can be operated by either the driver in the truck cab or by the man on the rear platform. For some operations the sprayer can be one-man operated.

The electric hoist is easy to make. A starter motor is connected to a sixty 1-worm gear reducer fitted with a 4-inch cable drum. The starter motor is wired to the truck battery in a special manner so that the starter motor is reversible. A worm gear reducer holds the sprayer boom at any position.

The boom used on the sprayer for our ditch banks is 24 feet long with a special nozzle on the tip which allows a wide area for additional coverage when needed. The boom is constructed of light weight aluminum antenna-tower sections and weighs only 2 pounds per foot. Antenna tower sections are supplied in 6-foot sections so that the completed boom can be built in multiples of 6 feet. To reduce weight, thin wall $\frac{1}{8}$-inch outside diameter steel tubing is used in preference to standard $\frac{3}{4}$-inch pipe. Eyelet nozzles are attached to the tubing by drilling one $\frac{7}{32}$-inch hole for each nozzle. Three-quarter-inch pipe nipples are welded into each end of the steel tubing to provide threads for pipe connections. The tubing is attached to the boom by a number of clamps.

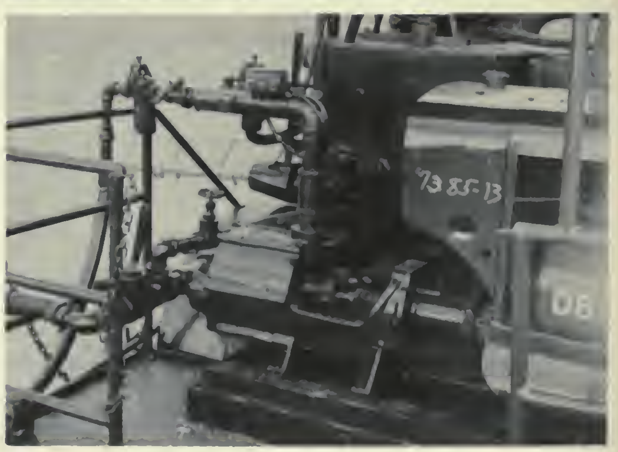
A tractor speedometer has been added to the sprayer for more accurate speed readings during spraying operations.

The features of this weed sprayer can be incorporated on present spray equipment or the entire unit can be built in the local maintenance shop with readily available materials and minimum labor.

For additional details regarding construction of the weed sprayer, it is suggested that you write to Regional Director Clyde H. Spencer, Sacramento, Calif., Box 2511, Bureau of Reclamation.

Details were worked out with the cooperation of Delbert Suggs, agriculturist, Columbia Basin project, Ephrata, Wash., and Region 2, Paul Baranak, former regional weed specialist.

Rear view of sprayer showing small side booms in photo immediately below. Four-stage centrifugal pump coupled to engine is shown in bottom photo.



Water is Wealth

by L. R. SWARNER, Irrigation Engineer, Region 1, Boise, Idaho

"Am I making the most efficient use of my irrigation water?" This is a question which should be uppermost in the mind of every farmer who applies water to his land. It is a question which becomes increasingly important as we continue to develop to its fullest extent one of the Nation's most important resources. The conservation of this natural resource, that is, the saving of water and putting it to its most beneficial use, has been the objective of the Bureau of Reclamation ever since the Congress of the United States, recognizing the importance of western water resource development, enacted the Reclamation Act of June 17, 1902.

The conservation and full utilization of irrigation water is a complex process which begins in the high reaches of the watershed and continues down through streams, storage reservoirs, canals, and laterals. Upon reaching its destination on the farm it becomes the lifeblood of valuable food and fiber crops. Admittedly some of this flowing wealth is lost in conveyance to the land, but how much of it are we, as water users, squandering on our farms? Reliable sources place estimates of such losses at approximately one-half of the water delivered to the farm. This is lost primarily as surface runoff and deep percolation. Can we afford to lose half of this precious wealth?

That irrigation water costs money is reflected in the water users annual charge for water. This charge is based on an amount of water considered necessary for good crop production with as little waste as possible. Generally speaking, there is an additional charge levied for the use of "excess" water, or water considered to be above the normal requirements on a given project. Probably greater losses than those sustained by the water users in paying for more water than they actually need, are those which the irrigation district face as a result of using excessive amounts of water. Water lost through deep percolation generally collects in lower areas rendering land unproductive because of a high water table which may concentrate harmful salts near the soil surface. High water tables are not only harmful to the soil but they contribute to wasteful use of water on the low-value crops which must be grown under these conditions and to water losses caused by excessive evaporation from bare lands where nothing can be grown. Large sums of money are spent to protect and reclaim such lands which would not have become waterlogged if proper irrigation practices had been carried out. In many cases the reclamation of seeped lands is prohibitive because the cost of drainage would exceed the value of the land.

Vast sums of money are lost each year through the leaching of plant nutrients of commercial and other fertilizers below the effective root zone of the soil by excessive use of irrigation water. Often the same or greater crop yields can be obtained with less fertilizer if the proper amount of irrigation water is applied, thereby saving the farmer considerable money.

The excessive use of water is generally associated with the use of large streams and excessive surface runoff, which tend to damage and erode the productive top soil. An argument commonly advanced by the farmers for the use of excessive water on the farm is that it costs more in labor to apply water efficiently. In actual practice higher water application efficiencies assure higher crop yields with less water, and the increase in crop production usually exceeds the increase in labor costs for efficient water application. This is especially important where water supplies are limited. Let us take a look at our irrigation practices to see how we may make the most efficient use of our irrigation water.

The objective of an irrigation should be to distribute water uniformly over a field so as to fill the soil storage reservoir in the effective rooting zone with a minimum of surface runoff, deep

Top Photo: SMALL CAREFULLY REGULATED STREAMS are indicative of good irrigation practices. Center: EXCESSIVE AMOUNTS OF WATER are generally required to irrigate land improperly prepared for irrigation. Immediately above: LARGE STREAMS OF WATER are often conducive to excessive waste through runoff. ***Top and bottom photos by Stan Rasmussen. Center photo by Phil Merritt.***

percolation, soil erosion, and a maximum efficiency in the use of water and labor. If you expect to irrigate efficiently, one of the most important things you need to know is how much water can be stored in the effective root zone of your soil and how much of the total amount is available for plant use. (See article Soil, Water, and Air, RECLAMATION ERA, March 1952.) Roughly, one-half of the total moisture held in the effective root zone of a soil is available for plant use. Usually, sands and loamy sands will hold from 1/4 to 1 1/4 inches of available water per foot depth of soil; loams will hold from 1 to 2 inches; and clays, from 2 to 3 inches. A knowledge of the rooting habits of the crops and the nature of the soil profile will enable you to determine the total available moisture in the soil. Your county agent or soil conservation technician will help you estimate the available moisture capacity of your soil. One common practice which contributes to the excessive use of water is to irrigate long before the plants have exhausted a sizeable portion of the available moisture in the root zone. On the other hand, an irrigation should not be delayed until all of the available moisture is gone from the rooting zone. To allow some margin of safety, an irrigation should be started when not more than approximately two-thirds of the available moisture has been used. The proper time to irrigate can soon be determined by watching the color of the crops and feeling soil samples secured by digging with an auger or shovel at frequent intervals. When you are ready to irrigate, an estimate should be made of the amount of water needed to replenish the moisture reservoir in the rooting zone on each field and an effort should be made to add only this amount of water, allowing for a reasonable waste. A very good method of computing the amount of water which is being added to the soil is to multiply the size of the stream (in cubic feet per second) by the number of hours the water has been running and divide this result by the area of land upon which the water has been applied. This will give you the average depth of the water applied to the area in inches. Stated briefly, the formula is as follows:

$$\frac{\text{size of stream (c. f. s.)} \times \text{hours of application}}{\text{acres}} = \text{average depth in inches}$$

Continued on page 69

Assistant Commissioner McPhail Retires

HARVEY F. McPHAIL

As this issue went to press, Secretary of the Interior Douglas McKay announced that Harvey F. McPhail, Assistant Commissioner of the Bureau of Reclamation since 1952, would retire effective July 31.

Mr. McPhail, an internationally known electrical engineer, has been a key figure in the Reclamation power program. He has been with the Bureau 35 years, and after his retirement plans to join a private firm as a power consultant.

He joined the Bureau in 1919 as powerhouse foreman at the Lingle power plant on the North Platte project in Wyoming. Previously, he served as an engineer for the Nevada Power Co. at Lovelock, Nev., and in electrical contracting and other business there. After a tour of duty at Lingle, he transferred to Cody, Wyo., as resident engineer on the Shoshone project. In 1924 he became assistant chief electrical engineer at the Bureau's Denver office. In this position, he was in charge of electrical designs for such world renowned projects as Hoover, Grand Coulee, and Shasta power plants of the Bureau, and Norris and Wheeler power plants of the Tennessee Valley Authority. He received the Department of the Interior Citation for Distinguished Service in May 1953 for his role in formulating the Reclamation power program.

Mr. McPhail became Director of the Bureau's branch of power utilization when it was established in Denver in 1943, and served in that post until he took over as Assistant Commissioner.

He is a native of Santa Barbara, Calif., and received his bachelor of science degree in electrical engineering from the University of Nevada. He was Chairman of the United States degelation to C. I. G. R. E. (International Conference of Large Electrical Systems) at Paris in 1948. He became a Fellow in the American Institute of Electrical Engineers in 1942.

Mr. McPhail married Ruth James in 1912. They have two children and live in Washington, D. C.

Central Valley Project Returns 5.5 Million Dollars to U. S. Treasury

Regional Director Clyde H. Spencer, in charge of the Central Valley project in California, in his annual report on project operations announced that the project has returned to the Federal Treasury over 5.5 million dollars in revenue from the sale of over 1,000,000 acre-feet of water and more than 2.2 billion kilowatt-hours of electric energy during 1953. The total net return to date from project operation amounts to $50,931,707.

Power produced at the Shasta and Keswick plants accounts for 87.4 percent of gross revenues to date and materially eased the cost of irrigation water to the farmers of the Central Valley. The report further pointed out that if water was not available at a price the farmers could afford to pay, many of the growers in the service area of the Central Valley project system would have found themselves in difficulties. Water deliveries during the year were up 40 percent over those of 1952.

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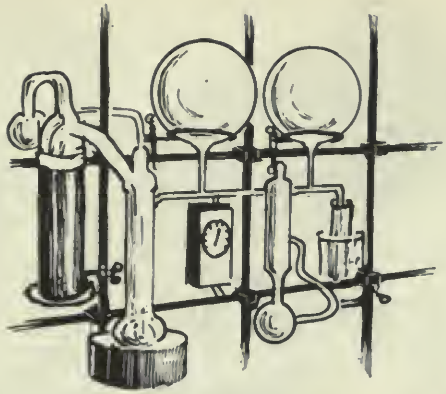


New Dates from Old Data

by JOHN M. CORBETT, Chief, Archeological Investigations, National Park Service

During the 18th and 19th centuries, traders exploring the Missouri Basin were unaware that it had been the homeland for wandering groups of Indians thousands of years before the advent of white men.

Today, we know a great deal more about these earliest inhabitants of our country, especially as to the probable time when they existed, than we did 10 years ago. Our knowledge has come about through the discovery of a usable and accurate method for determining dates from archeological materials.

The dating of certain ancient remains is now possible through a scientific process developed by Dr. W. F. Libby of the University of Chicago. Recent investigations with radioactive materials showed that in all living matter there was a radioactive substance which the scientists have called Carbon-14. It is an isotope of the element Carbon and is initially formed in the upper atmosphere by the action of cosmic rays. Later it is absorbed into all living matter at a constant rate—both plants and animals as well as man. At the death of the living organism, the absorption of Carbon-14 ceases. From then on, the amount of Carbon-14 in the remains decreases at a steady measurable rate. In 5,568 ±30 years, half the radioactive material has disintegrated. In another 5,568 ±30 years, half that remainder again is gone, and so on. By measuring the amount of radioactive material left in a formerly living specimen, it is possible to determine, within a reasonable statistical error, the date when the specimen was a living organism.

Wood, fiber, or vegetal material lends itself well to dating by the Carbon–14 method, especially if the sample for testing has already been burned. Charcoal from a fireplace, if in sufficient quantity (4 ounces is needed), is admirable, since it will tell very closely the date when the fireplace and associated remains were being utilized. Bones, if already charred, and in larger quantities, can also be used. Even wooden artifacts, from which four ounces can be removed without seriously damaging the specimen, are excellent for testing.

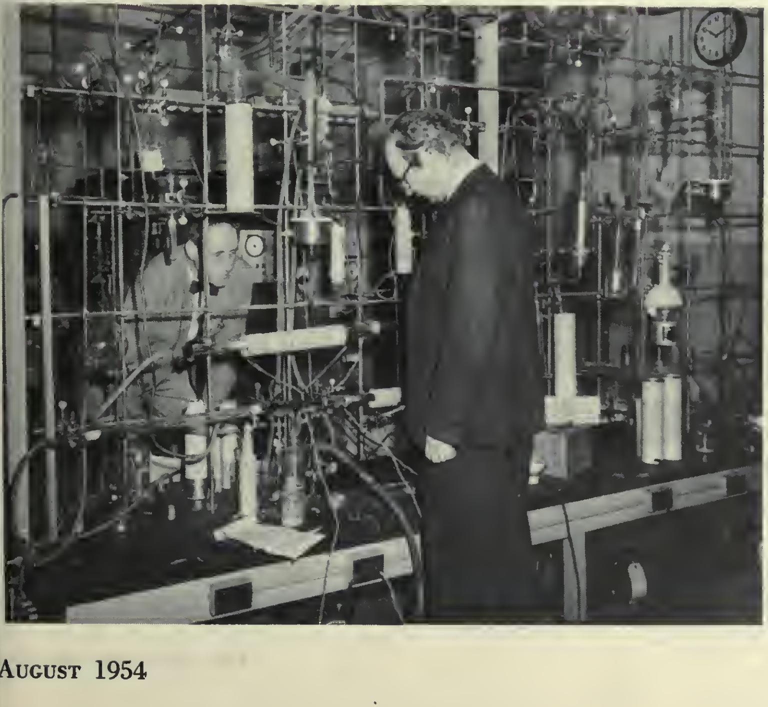
Since the summer of 1953, the Federal Geological Survey has had a Carbon–14 laboratory in operation in Washington, D. C., under the direction of Dr. Hans Suess. Dr. Suess' method, which he developed himself, differs from that used by Dr. Libby in Chicago and Dr. Suess is able to date specimens back as far as 30,000 to 35,000 years before present time.

And how does all this help the archeologist, the geologist, or other scientists, and how does it increase our knowledge of the country's past?

The answer to that question can best be shown by citing an example. In 1949, Smithsonian Institution River Basin Survey archeologists in the Bureau of Reclamation's Angostura Reservoir, S. Dak., excavated the Long site which contained two deeply buried fireplaces and associated artifacts. When had the Indians lived there? How rapidly had the overburden first accumulated and then eroded? Archeologist Richard Wheeler did not know, but he suspected it was a long time ago (that is not how the site got its name). Ten years earlier, Wheeler would have compared the artifacts with others from supposedly ancient sites, sought geologists' advice and estimates as to length of time for the accumulation and erosion of the overburden, and after much study and discussion,

he would have come up with a "guess-timate" age. But not today. The artifacts are just as carefully studied, but the age of the site is no longer a guess. Wheeler carefully gathered and saved all the charcoal from each of the fire pits and shipped the two lots off to Dr. Libby in Chicago. In due course of time, he received his answer. One lot gave a date of 7,073±300 before present time; the other a date of 7,715±740 years before present time. Translated to our chronology, we now know that during the 5th millenium before Christ, Indian hunters were inhabiting this area.

Increasingly, throughout the Missouri Basin evidence is coming to light of early habitation of the area. Carbon-14 samples from a site at Lime Creek, also in the Medicine Creek reservoir area,



DEEPLY BURIED "EARLY MAN" SITE (above) on Lime Creek, Medicine Creek Reservoir, Nebr., being investigated by University of Nebraska State Museum and National Park Service personnel. Carbon—14 analysis gave a date of about 7573 before present time. At left: Dr. Hans Suess, Chief, Low-level Radiation Laboratory, U. S. G. S. (foreground) and the author (background) watch a test run of material submitted for Carbon—14 analysis. ***Top photo, courtesy Smithsonian Institution; left photo, courtesy U. S. G. S.***

TRACES OF ANCIENT INDIAN CAMPSITES were revealed by the cooperative investigations of the Smithsonian Institution and the National Park Service in the shadow of Angostura Dam, built by the Bureau of Reclamation on the Cheyenne River in South Dakota. The lowest occupation level at another of these sites yielded a Carbon—14 date of approximately 5,850 before present time, furnishing another link in the growing proof of the respectable antiquity of the American Indian. *Photo courtesy of the Smithsonian Institution.*

yielded an average date of 9,524±450 years before present time. In Keyhole Reservoir, Wyoming, a small rock shelter was evidently inhabited at 2,790±350 before present time. Another such shelter, near the dam, gave an average date of 1,646±200 before present time.

Carbon-14 dates are of great interest to geologists and soil experts as well as to archeologists for any plant or vegetal remain can be tested. For example, pollen from Singletary Lake, N. C., was found lying between lake sediments thought to represent the Mankato and Cary substages of the Wisconsin Glacial Stage. These pollen samples gave a date of "older than 20,000 years." At Lubbock, Tex., burned bone from a soil stratum overlying mammoth bones has yielded a date of 9,883±350 which indicates that in this area, at least, the mammoth may have been extinct by that time. Wood and peat samples, thought to have been formed at the time of the last glacial advance (the Mankato) gave average dates of 11,404±350 before present time. These and other similar dates indicate that the last advance of the great continental ice sheets is much more recent than geologists had formerly thought.

Dates from other areas outside the Missouri Basin also indicate a respectable degree of antiquity for early population of the rest of the United States. But it is in the Missouri Basin that this new method is of special interest, for it is there we are learning how man may be able to adjust part of his environment to suit himself. Toward this end ever since 1945, the National Park Service, with the cooperation of the Bureau of Reclamation, the United States Corps of Engineers, the Smithsonian Institution and many state universities and museums, has sponsored the Inter-Agency Archeological Salvage Program.

Taming the "Big Muddy" and other rivers of the Basin to be productive instead of destructive, is only part of the story. How mankind lived there yesterday, and many yesterdays ago, is the rest of the story. # # #

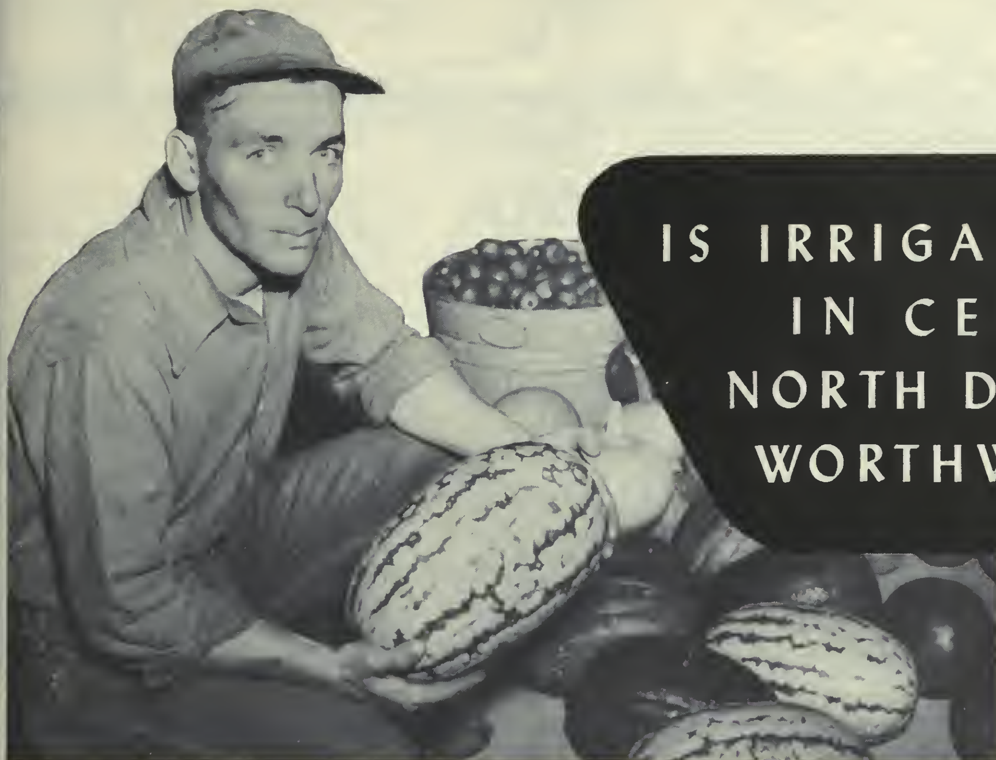
Coachella Grapes

Continued from page 50

avoid the devastating effect of the high temperatures on fruit quality. About 5 or 6 days after the fruit is picked in California it may be sold in New York. Shipment to the East usually is made by refrigerated express. To the closer markets, trucks are used.

The Thompson Seedless variety makes up by far the largest portion of the valley's production at present but new varieties are being developed by the University of California breeding program so that new and earlier varieties such as the Perlette, Delight, and Beauty Seedless are assuming more importance. The Cardinal, a red seeded variety developed by the United States Department of Agriculture also is popular with some growers. Probably most future plantings will be to the new varieties, and some growers are considering grafting over to these earlier producing types.

As production increases from the larger acreage now in vineyards the problem of marketing will assume greater importance. Already university representatives have made intensive studies of the Coachella fruit in the eastern markets. They are agreed that if the industry is to continue profitable for all, the keynote must be quality, and most growers are agreed on the importance of improving the finished product. With proper attention to this aspect they feel they have every right to expect much of their future. # # #



IS IRRIGATION IN CENTRAL NORTH DAKOTA WORTHWHILE?

Development of the large scale Garrison diversion unit of the Missouri River Basin project in North Dakota poses a prime question for everyone concerned with it. WILL IT BE GOOD BUSINESS AND A SOUND INVESTMENT FOR THE NATION AND THE FARMERS TO DEVELOP NEARLY A MILLION ACRES FOR IRRIGATION FARMING IN THIS SUBHUMID AREA OF CENTRAL NORTH DAKOTA?

To provide partial answers to this question the Bureau of Reclamation has established the Deep River development farm in the proposed Missouri-Souris project area of north central North Dakota, an area which contains more than half of the potential irrigable acreage of the unit. The farm is operated on a crop-share type of agreement by a local former dryland operator to show other farmers just what irrigation might mean on their own comparable acreage.

Stener Hillerud (photo above), the lessee of the farm, which lies 50 miles northeast of Minot, is already convinced that he can earn a good living and derive a stable income for his family from irrigation farming.

In January 1953 Mr. Hillerud was selected, from a group of 40 applicants, to be lessee of the 160-acre farm. The farm includes 103 acres of irrigated land for general farming operations, 17 acres which are used by the North Dakota Agricultural College and the United States Department of Agriculture for irrigation research, 12 acres of dry farmed land and 28 acres of farmstead, shelterbelts, and wasteland. Last season was Hillerud's first experience with irrigation farming. With some guidance during the first irrigation and during seed bed preparation and planting, he handled the irrigation farming operations without difficulty. He ably demonstrated how a good dryland farmer could convert to irrigation farming.

Mr. Hillerud's convictions that a general irrigation development will be a good investment for the area are partially based on crops grown this season. Red pontiac potatoes produced 480 bushels per acre and were about 95 percent grade 1. Eight acres of corn, planted June 9, yielded 75 tons of silage. A 50-bushel per acre oat crop was harvested from fields planted to oats with alfalfa or pasture. Barley seeded with alfalfa yielded about 30 bushels to the acre. These yields were good for fields that had just been subjected

Above left to right: G. A. Freeman, Bureau of Reclamation, and E. G. Gahley inspect Deep River Farm corn (yields exceeding 80 bushels per acre in some fertility trials). S. W. Hillerud, lessee of the farm and Kenneth Braaton weighing Pontiac potatoes. George Cheney, Chief of Investigations, Minot Field Office of the Bureau of Reclamation and Alvin Kramer, McHenry County agent examining irrigation pump. Right center photo: William Freeman, Bottineau County agent; Alvin Kramer; L. R. Jensen, B. P. I. soil scientist; and lessee Hillerud examining sugar beets which yielded 15 tons per acre on fertilized plots. Lower right: George Cheney and G. A. Freeman visiting farmyard at Deep River.

to leveling and had some of the top soil stripped away. Hillerud believes that small grain yields will be doubled after the farm has been in operation a few years.

While irrigation farming has kept him as busy as the proverbial bee this first year, Hillerud plans to increase his irrigated acreage and combine it with some nearby dryland farming. With some extra help at planting and harvest time, he feels that the two types of farming can be dovetailed nicely. It is his belief that he can handle 130 to 140 acres of irrigation and a quarter section of dryland. This type of farming is expected to be common when the project develops.

Mr. Hillerud's plan for a successful farming program includes milking 15 dairy cows, keeping a herd of 20 or more beef cattle, and raising a few hogs. Cash row crops along with forage and grain will round out his program.

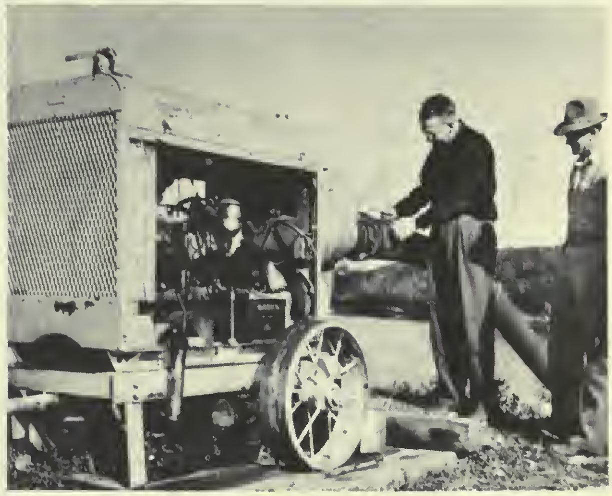
The Hillerud's have found irrigation farming in the heart of central North Dakota's dryland farm belt is something like living in a goldfish bowl. Many farmers have come to visit the farm from miles around. In fact, several out-of-State irrigation farmers stopped in and asked a lot of questions. County extension agents in McHenry and nearby Bottineau Counties also are getting a lot of questions about the irrigation farm and make regular inspection trips there to keep informed.

William Freeman, Bottineau County agent, feels that the results of the first year of operation at the farm have been "very encouraging" and offers a real hope for stabilizing the area's agriculture. "The land is typical of much of that proposed for irrigation," Freeman said, "and farmers naturally are interested in getting a yardstick to measure irrigation benefits on their own farms."

Alvin Kramer, McHenry County agent, said the questions asked of him indicate that farmers are interested in irrigation from the standpoint of combining it with their dry farming, rather than going into it exclusively.

Although Mr. Hillerud is doing his own farming and making his own decisions, he gets advice from personnel of the Bureau of Reclamation, North Dakota Agricultural College, and the Department of Agriculture. In addition, a group of successful dryland farmers, interested in irrigation and living in the immediate area, serves as an advisory committee.

Mr. Hillerud is interested in irrigation research but his efforts are confined to his general farming operations. He is keeping accurate cost and production records which will be useful in evaluating



the benefits of irrigation.

A part of the farm is used solely for research purposes. The United States Department of Agriculture, cooperating with the State experiment station is testing varieties, crop adaptabilities, and fertility factors in crop rotations. The selection of the most suitable forage crops, and determining the value of commercial fertilizers is important in this northern area. The State experiment station is doing research work in soil erosion, irrigation techniques, and water requirements.

Information gathered by the research agencies, together with results of practical irrigation farming will provide answers to numerous questions related to project development.

People in this portion of the proposed project area will be provided with "first hand" information on the changes required by the transition to irrigation, to become familiar with the value of a more stabilized agriculture afforded by it, and a "know-how" to implement these ideas when the project becomes a reality. This participation of local, State, and Federal interests is essential to demonstrate the value of irrigation in this area and whether it is a sound, practical investment for the future of the individual, the State, and the Nation.

# # #

TEAMWORK PAID OFF

How Gila Project Settlers Solved Their Power Problem

by MAURICE N. LANGLEY, Yuma Projects Office, Region 3

"If you want a job done in a hurry, do it yourself." This philosophy has really paid off for a group of new homesteaders on the Yuma Mesa unit of the Gila project in southwestern Arizona.

When 27 new entrymen were awarded farm units in the fall of 1952, one of their first problems was getting electric power to their homesteads. The Arizona Public Service Co., the utility serving the Yuma area, initially estimated that the cost for the additional line extensions might run as high as $500 per family. Moreover, allocations on certain important materials, plus the large demand for these same materials to expand electrical facilities in the rapidly growing city of Yuma, Ariz., made the outlook for 5 or 6 miles of additional lines to serve the entrymen look pretty dark. However, H. H. Idle, manager of the Yuma office of the company at that time, agreed to look into the availability of materials in connection with other work the company was doing in the State.

Alfred R. Williamson, the company's local sales supervisor, worked closely with Bureau of Reclamation representatives studying the expected agricultural growth and potential of the area in which the new homesteads are located. When a meeting was held with the entrymen in January 1953, W. P. Reilly, divisional vice president in charge of operations, announced that he had both good and bad news for the entrymen. The necessary materials had been located and the new lines would be installed without charge to the entrymen as a part of the company's expansion program and expression of faith in the growth of the community. But with all of the other construction work going on in the area, the company had been unable to find qualified linemen or the necessary truckdrivers and groundmen to make up line crews.

At this stage in the meeting, the entrymen came to the rescue. Lawrence A. Lemke, formerly of Fullerton, Calif., stated that he had several years'

experience as a lineman and would be glad to work on one of the line crews, while managing development of his new farm, if it would help speed up getting electricity to the homesteads. Harold Harkey, of Klamath Falls, Oreg., spoke up and announced that he, too, had experience as a lineman and would be glad to pitch in and help.

Ferrial D. Allen from Nogales, Ariz., reminded them that it would be necessary to use 4-wheel-drive equipment in the sandy desert area which comprises the homesteads. He explained that he had had considerable experience in handling this kind of equipment and could help out in the capacity that the public service company designates as class A truckdriver. Ralph E. Nixon with experience in handling 4-wheel drive truck equipment, also agreed to work as a class A truckdriver.

Brooks Faulkenberry and Wilbur Moore said they had no special qualifications as linemen but, since they wanted to get electricity into their places before starting their new houses and farm development, they would be glad to work on a line crew as "groundmen." To make sure that line crews could be kept at full strength and to speed up the work as much as possible, Armsted M. McKinney, Hosea M. Whitten, John Anderson, and A. K. Harvick all agreed to work as groundmen whatever time they could spare from farm development operations.

The Arizona Public Service Co. placed these men on their regular payroll at the full wage scale for the grades in which employed and furnished its truck and line foreman, Henry C. Outwell. The entrymen put in all the time they could spare on the line crews working under Phil A. Neese, electrical superintendent.

Asked how the cooperative deal worked out, Ralph White, general superintendent of electricity, water, and gas for the public service company declared: "Without their help I don't know when we could have started the work. They have been first-class employees and by helping us have helped themselves."

# # #

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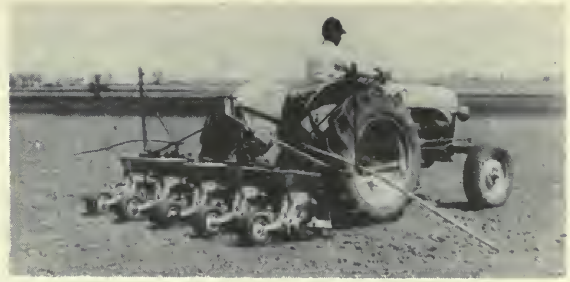


PRECISION SEEDING EQUIPMENT for uniform seed placing

Sugar Beet Seed, A New Industry

by Harvey P. H. Johnson, General Agriculturist and Dr. Andrew R. Downie, Assistant General Agriculturist, The American Crystal Sugar Co.

Only 20 years ago, the American beet sugar industry was dependent on European sources for all of its seed. The development of an American beet seed industry has been the result of an intensive and well directed agricultural research program. It is obvious to those familiar with agricultural problems that this advancement took time and a great deal of effort.

As is well known the sugar beet is a biennial. It produces the sugar-rich root during the first growing season and if the roots are dug and stored under favorable conditions of temperature and moisture, these roots when planted the next growing season will produce seed. In brief, this is the European method of sugar beet seed production. These procedures require a great deal of hand labor as well as considerable storage facilities. In order for an American seed enterprise to be successful, it was recognized at an early date that the elimination of much of the hand labor was imperative.

In the United States, sugar beet seed raising has centered in a few areas in Arizona, California, and Oregon. The climate in these localities is such that beet seed planted in August and September develops a large enough root so that it can successfully live

through the relatively mild winters and produce a seed stalk when weather conditions are favorable the following spring. Because of the tangled mass of foliage and entwined beet seed stalks, special harvesting and threshing equipment has been developed for handling this crop.

During the last 10 years, there has been gradual improvement in yield and quality of seed. These improvements have been made by better agricultural practices, such as proper fertilization, better irrigation practices, and the use of more effective insecticides. Seed yields have been increased from less than 2,000 pounds per acre to more than 4,000 pounds per acre.

The American beet seed industry has eliminated all of the costly hand labor methods characteristic of the European practices. In addition, the American grown varities have assured the beet grower more security since these American developed varities are better adapted, and for the most part resistant to the diseases that are likely to occur in his particular locality.

The above developments have been possible through the cooperative efforts of the United States Department of Agriculture, State agricultural colleges, and the beet sugar industry.

Far reaching developments have been taking place in sugar beet agriculture. Approximately 10 years ago the sugar beet agriculturists really took the first important step in the reduction of hand labor required for beet thining. This was the development of processed seed. Normal beet seed contains more than one embryo and varies tremendously in size. In order to make beet seed more drillable, it is now mechanically reduced so that its size range varies from 7 to 10 sixty-fourths of an inch. Also in reducing the overall size of the seed the number of locules per seed unit are also reduced. This seed, planted with recently developed precision drills, is placed an inch or more apart in the seed row. This is conducive to getting uniformly spaced seedling stands which can be thinned with either down-the-row or across-the-row thinning machinery. All that is left for the hand labor to do is to hoe out the weeds.

The rapid progress made during the last few years in mechanized sugar beet agriculture has been more thoroughly covered in the February 1954 issue of the Reclamation Era.

It has been mentioned that American varieties are better adapted to growing conditions in the varied climates where sugar beets are grown in this country. In addition to these accomplishments, the sugar beet plant breeders are now working out the technics for the production of hybrid varities and also the production of single germ seed. The increase in yield expected from the use of hybrid varities, the potentialities of further mechanization of the spring work by the use of single germ seed, the increases in yield of sugar per acre by better farm practices, such as, use of green manure crops, judicious use of commercial fertilizers and better insecticides, have made the beet crop more attractive in recent years. The elimination of much of the hand labor required, combined with the so-called readjustment of prices of other crops has compelled a great many farmers to consider growing sugar beets. The overall advances in sugar beet agriculture to date have been farmer-industry accomplishments aided by Federal, State and local cooperation. It is for this important reason that the farmer-industry combination will continue to invest money in modern equipment to eliminate hand labor and cut costs of production in sugar beet agriculture and in the manufacture of sugar from sugar beets.

# # #

All photos for this article, courtesy of The American Crystal Sugar Co. Annual Report

"Down—the—Row" THINNING

"Cross—the—Row" THINNING

BOB HART of Bismarck trying out his new boat and motor.

RECREATION AT HEART BUTTE

Heart Butte Reservoir, created by Heart Butte Dam, located in southwestern North Dakota, about 70 miles from Bismarck and Mandan, is already high on the list as a favorite recreation spot in the State. The management plan adopted for this reservoir has set a pattern for other recreational areas in North Dakota. Administration of the lake surface and adjoining land has been turned over to the State of North Dakota.

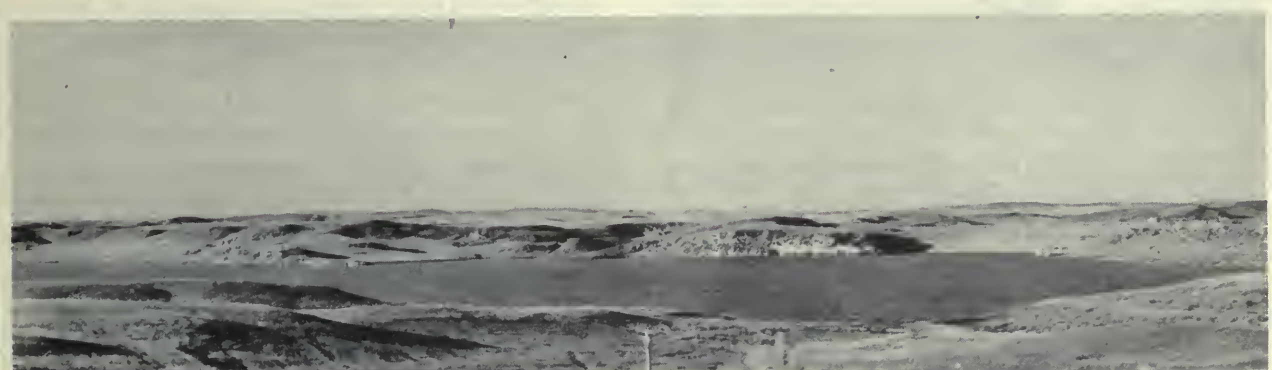
For the first time residents of the "west river country" of North Dakota are enjoying a good sized lake right in their own back yard, and it is no longer necessary for them to travel 400 or more miles to neighboring Minnesota or Canada to find excellent fishing. These people have really "taken" to the Heart Butte area for outings—spring, summer, fall, and winter. The new reservoir is an ideal spot for camping, family outings, hunting, fishing, and boating.

Organized camping, seasonal cabin site development, and provisions for the day-use areas are already well underway. Fish and wildlife habitat plantings have been established and increasing numbers of upland game and migratory waterfowl are evident. Mule deer and white-tailed deer have been noted in increased numbers since the impoundment.

Adjacent agricultural lands not required for other purposes are made available for livestock grazing. A strip of land 300 feet wide around the perimeter of the reservoir has been reserved for recreational use and is not included in the areas leased for agricultural purposes. This allows the public free access to the entire shoreline of the lake.

North Dakota Highway No. 49 crosses the dam about midway between the towns of Elgin and Glen Ullin and affords a good view of the pool which contains 75,000 acre-feet of water at normal operating level. It is a man-made lake having a water surface of more than 6,600 acres. Heart River Valley farmers will ultimately use a part of

HEART BUTTE RESERVOIR



At top: View across part of the lake behind Heart Butte Dam. Center: Grandpa and the boys fishing near Lignite Bluff, Heart Butte Reservoir. Immediately above: Getting the boats ready for the 1954 season. *All photos by G. A. Freeman, Region 6.*

the stored waters for irrigation in downstream areas. Its value as a flood control structure to protect downstream areas during the annual snow melt season has been amply demonstrated. During 1950 when a record runoff took place, Heart Butte Dam contributed by storing more than 146,000 acre-feet of water which would have otherwise caused damages amounting to millions of dollars to the lower valley areas and the city of Mandan.

Recreational and agricultural resources of the reservoir area are administered by the North Dakota Game and Fish Department under terms of an agreement entered into by the State of North Dakota with the Department of the Interior. Income from the rental of grazing lands, cabin sites and commercial concessions is used by the State to construct and maintain facilities which improve the area for public use and contribute to the conservation of soil and wildlife. Recreation facilities are being constructed in accordance with plans outlined by the National Park Service. The Bureau of Reclamation has established 880 acres of wildlife habitat including 100 acres of trees and shrubs in 12 areas as planned by the Fish and Wildlife Service. This habitat will be maintained by the State.

The administration plan is proving to be very workable, and eliminates an expensive administrative problem for the Bureau of Reclamation, and at the same time affords good cooperative work and technical assistance from the Fish and Wildlife and National Park Service agencies. By a Memorandum of Understanding the Bureau of Reclamation agrees to turn the acquired area over to the State for administration and to furnish other technical assistance. The State agrees to administer the property, using revenues to build and improve the area. The Fish and Wildlife Service agrees to provide plans for wildlife habitat development, make periodic inspection of habitat work, and to provide recommendations on administration along their lines of endeavor. The National Park Service has agreed to provide plans for the recreational development, to provide technical information on the aspects of this activity. The agencies meet periodically to discuss reservoir management practices, future plans, and if necessary, to take corrective action on management practices.

The best part of this whole arrangement is that

Continued on page 71

REMOVAL OF TOPSOIL is often reflected through poorer plant growth as shown in stunted cornfield (at right). *Photo by Phil Merritt, Region 1.*

HOW TO FARM THE SUBSOIL

by Dr. FRANK G. VIETS, Jr., Principal Soil Scientist, Soil and Water Conservation Research Branch, Agricultural Research Service, United States Department of Agriculture, Fort Collins, Colo.

Why should anyone want to farm subsoil?

Well, no farmer wants to, but subsoil is frequently what he has on parts of a field where deep cuts have been made in leveling land for irrigation. Even the "fills" may resemble the "cuts" if subsoil was moved into the depressions.

However, not all cuts are made by man. Prior to reclamation many desert soils were subject to erosion by wind and water and little top soil developed. Hence, these eroded knolls are also essentially subsoils and a part of the problem.

This article is not written to discourage land leveling where essential for efficient and effective irrigation, because experience shows that judicious land leveling pays even though "bald" spots in the field result. Rather, it is written to encourage farmers and those obligated to help them to determine why the "bald" spots are unproductive and to correct the condition before large dollar losses have accumulated through the years. Of course if a soil is shallow—less than 24 to 30 inches to bedrock, sand or gravel—then any removal of top soil will result in loss of productivity that can only be partially restored by good soil management. This fact is clearly recognized by most irrigation people.

Not all subsoils, laid bare by erosion or leveling, are unproductive. Some of them, where the profile is comparatively uniform in texture and other characteristics with depth, are just as productive after 1 or 2 years of irrigation as the rest of the field. Such cases occur on almost every reclamation project.

On the other hand, many cases exist throughout the West in which these subsoil areas produce low yields or are actually barren and remain that way for many years. In the Yakima Valley there are areas in hop yards that have produced no marketable hops for 30 years. Heavy applications of manure, organic residues, and non-zinc-containing fertilizers were applied to this land but were of little value. Finally, it was discovered the soil contained an acute zinc deficiency.

Although bare spots in fields may occupy only a small percentage of the area, the loss in production on them comes directly out of profits. The farmer has to pay the same water charges, taxes, tillage and other operational costs on them that he does on the productive areas. Hence, these areas are not only unsightly but are also eating up the profits. For these reasons the owner is justified in spending more money per acre on improvement of such areas than he could profitably spend on the field or farm as a whole.

The problem then becomes one of diagnosing the trouble, finding a remedy, and using it. Suffice it to say that in too many cases we have the diagnosis, but not a practical remedy.

For a better understanding we should look first at a normal soil composed of a topsoil and a

subsoil. Within the topsoil all factors affecting root development and plant food uptake are generally more favorable than in subsoils. The topsoil contains the bulk of the soil organic matter and nitrogen, and the availability of phosphate, manganese, iron, zinc and other nutrients is usually greater than in the subsoil. The permeability of the topsoil to water and air is generally greater than the subsoil. Its physical condition or tilth is better.

Now if the topsoil is removed, other factors come into play to limit crop growth, for the plant is now completely dependent on subsoil. One of the most important of these factors is the poor physical condition of the soil which restricts water intake and movement and root development. The latter appears to be very important in the uptake of fertilizer elements like zinc or phosphorus that do not move, or move slowly, in the soil water. Roots must grow to these plant foods. At least some of the poor crop growth on "cuts" in the Columbia Basin project is due to poor root development caused primarily by a lack of nutrients in the soil.

Other causes of poor growth are actual deficiencies of available plant food in subsoils. Nitrogen shortage is almost universal on such areas. Phosphate deficiency is a close second. Zinc deficiency is widespread on such areas in the Columbia Basin and Yakima projects. New evidence obtained at the Northern Great Plains Field Station indicates that zinc deficiency may be a problem on leveled soils in North Dakota also.

Lime-induced chlorosis, an extreme yellowing of leaves which responds to treatment with iron salts applied to the foliage, is quite common in the West when subsoils are calcareous or limy. It is worse where topsoil has been removed. Avoiding over-irrigation reduces the severity of the symptons.

Calcareous subsoils are frequently more infertile than noncalcareous subsoils. However, the exact role that the lime plays in reducing nutrient availability is not well understood. There are soils like those in the Cache Valley in Utah and the Blacklands of Texas that are fertile even though they have a high lime content.

One other cause of "bald" spots in fields should be noted and that is alkali. This is due to an accumulation of sodium on the soil clay which causes the soil to swell and shed water when wetted. These are the "slick spots" found in southern Idaho, western Colorado, and elsewhere. This problem occurs whether soils are leveled or not. They will not be discussed further except to mention that their improvement is particularly difficult.

Another cause of low productivity on cuts is the compaction of soil by heavy leveling equipment when the soil is too wet. This is more serious on heavy soils than on light soils (sandy loams). Yield reductions from this cause are usually overcome with a year or two of normal tillage.

With this background, we can discuss practical methods of eliminating "bald" spots caused by leveling or erosion. First, and probably most important is the addition of organic matter to such spots to improve their physical conditions by growing legumes and spreading heavy applications of manure and crop residues on them. Growing alfalfa and green manure crops is not too effective sometimes because they will not produce sufficient growth on the bald spots for the very same reasons that cash crops fail. If manure is used it should be free of noxious weed seeds.

Generally on such areas phosphate and extra amounts of nitrogen fertilizers should be used until crop growth materially improves. On the Columbia Basin project and parts of the Yakima Valley these cut areas frequently require zinc. The use of 8 pounds of zinc per acre as zinc sulfate has been of great value, particularly when beans were grown. Other crops may also be benefited.

Help from county extension agents, Soil Conservation Service technicians and experiment stations should be obtained in diagnosing and correcting these problems. Exposed limy subsoils can usually be made into more productive topsoils with a little time and good soil management.

# # #

DO YOU KNOW . . . .

- In Vallecito Reservoir, key feature of the Pine River project, more trout have been produced in a shorter time than in any comparable body of water in the State of Colorado?
- At the time of its completion in 1908, the 6-mile Gunnison Tunnel of the Uncompahgre project in Colorado was the longest irrigation tunnel in the world?
- That the gate tender at Deadwood reservoir of the Boise Project is snowbound 5 months of the year, his only contact with the outside world being via short-wave radio?

Water is Wealth

Continued from page 54

In order that only the necessary amount of water be applied to the field, it is important that the field be properly prepared for irrigation. This means that the high spots have been leveled off and the low spots or hollows filled through leveling or smoothing. The fields should be laid out with the proper length of run for the particular type of soil or slope. Some positive means of distribution and regulation must be provided to keep the water under control at all times.

Difficulties often arise in attempting to apply only the amount of water necessary to replenish the soil reservoir in the effective rooting zone. For example, it is possible that after the required amount of water is applied, the lower end of the field may not have received any water, whereas the upper portion of the field has absorbed it all. There may be a number of reasons for this, the most important of which is the rate of application of irrigation water. The water should get through the furrows, corrugations, or to the lower end of the field in a reasonable time to permit both vertical and lateral subbing as uniformly as possible throughout the entire length of run. It has been suggested by technicians that at least one-quarter of the time required for the entire irrigation is a reasonable time in which to get water to the far end of the field. There is no objection to getting the water through the furrow in a shorter time providing it can be done without serious soil erosion.

After the water reaches the far end of the field and runoff occurs, it is necessary to "cut back" or reduce the head or stream during the time allowed for proper subbing. The stream of water should be reduced so that, as nearly as possible, only a small trickle of water is running from the end of each furrow. In some cases the objectionable feature of making a new "set" with the water which has been "cut back" may be eliminated in row crops by diverting a stream of sufficient water for 2, 3, or 4 furrows and placing the entire stream alternately in each furrow unitl the water has reached the far end of the row. The stream is then divided equally in each of the furrows and allowed to run until the proper subbing has taken place. When sufficient moisture has been added to the lower end of the field, the water should be shut off or changed to a new set.

Irrigation studies carried out on development farms have shown that with proper care and handling it is possible to obtain high irrigation efficiencies with very little additional work. With the beginning of the new irrigation season, take a new look at your irrigation practices and ask yourself, "Am I making the most efficient use of my irrigation water?"

# # #

TRACTORS VERSATILE

In case of electric power failure, it is often possible to use the farm tractor to operate the milking machine, suggests O. J. Trenary, agricultural engineer for the Colorado A & M Extension Service.

A tractor intake manifold develops a vacuum of 18 to 22 inches and since only 10 to 16 inches of vacuum is necessary to operate a mechanical milker, the tractor offers a solution to the power failure problem at milking time.

To equip a tractor for emergency milking purposes, do this:

Drill a hole in the intake manifold and thread it for ⅛- or ¼-inch pipe fitting which has been welded or soldered to a garden hose connection. Provide a means for plugging this when the tractor is being used for conventional purposes. Leave the original vacuum tank in the milker line because it aids in maintaining a constant and even vacuum.

Be sure to keep the relief valve in the milker system operating since a tractor produces a higher vacuum than the milker requires. It may be necessary to keep a close check on the vacuum gauge and the rate of pulsation while the milker is being operated and adjust tractor speed accordingly. Slow engine speeds give the greatest vacuum.

The stall cocks should be opened gradually because a sudden change in the line vacuum may stall the engine. To avoid fouling the tractor engine by continued slow operation, keep the radiator temperature at near boiling and run the engine at higher speeds for a short time after milking. (Reprinted from the February 1952 issue of the Colorado A & M News.)

YOUR MAGAZINE

Are there particular types of articles which you would like to see in the Era that we have not printed to date? If so, please let us know, and we shall do our best to comply with your wishes.

Left to Right.:—Mrs. Ernest H. Reed, Mr. Reed, Acting Reclamation Commissioner Harvey F. McPhail, and Mr. Reed's daughters Mrs. E. E. McNeil, and Mrs. John W. H. Spencer.

Ernest H. Reed Retires

Ernest H. Reed, agricultural economist in the Irrigation Division of the Commissioner's Office, retired on April 30.

Upon retirement, after 33 years Government service, Mr. Reed received the Department of the Interior's Meritorious Service Award. The citation, accompanying the award, was signed by Secretary of the Interior Douglas McKay, and read in part as follows: "Mr. Reed worked continuously for the full and efficient use of soil and water resources. His experience in the fields of agriculture and irrigation have extended to all of the major sections of our country and have been of inestimable value to the Department of the Interior." The presentation was made in the Commissioner's office by Acting Commissioner McPhail before Mr. Reed's wife and daughters, and a large group of his friends and associates.

He is a native of McConnelsville, Ohio, and a graduate of Ohio State University where he received his Master's Degree in Agriculture. He began his Government service in 1921 as county agricultural agent for Guernsey County, Ohio, later working for the Extension Service and Soil Conservation Service of the Department of Agriculture. Mr. Reed joined the Department of the Interior in 1942 serving with the War Relocation Authority, and subsequently the Bureau of Reclamation.

How does he plan to spend his retirement? Taking it easy and traveling leisurely. #

DAMS AND CONTROL WORKS

(Latest edition)

Now Available

A comprehensive report on dams and other Reclamation engineering accomplishments, over the past 50 years, the third edition of Dams and Control Works has just been published by the Bureau of Reclamation.

This new edition of the report, last published 15 years ago, has been completely revised and simplified. Dams and Control Works presents an outline and summarization of the Bureau of Reclamation's experience in the design and construction of dams and control works. Articles on individual structures, written by members of the Bureau's engineering staff, were selected to exhibit the wide range of sizes, types, and designs of the dams, spillways, and outlet works that the Bureau has used under varied topographic, foundation, and climatic conditions, materials availability, and water need and use.

Detailed design drawings and site layouts have been replaced by highly simplified, functional representations. A special article on the overall phases of dam design covers the general considerations and problems facing the dam designer. Another describes the types and usage of gates and valves; and a brief resume describes the scope of Reclamation engineering.

Dams and Control Works can be purchased from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. or the Bureau of Reclamation's office in the Denver Federal Center, Denver, Col. (Attention 841). The cost per copy is $2.75. #

R. J. Newell Appointed to Upper Colorado Commission

R. J. Newell, formerly Regional Director for the Bureau's Region 1 office at Boise, Idaho, recently was appointed Chairman and United States member of the Upper Colorado Commission by President Eisenhower.

Mr. Newell retired from his post as Regional Director in 1949. He subsequently served as consultant for the Bureau and also as a consultant to foreign governments having irrigation problems.

As chairman of the Upper Colorado River Commission, he succeeds Harry W. Bashore, former Reclamation Commissioner. #

Recreation

Continued from page 66

it provides for local management. Here is another example of partnership that can pay dividends. The North Dakota Game and Fish Department is actively engaged in conservation work throughout the State and has specially trained personnel in various fields closely associated with reservoir management. In addition, their local wardens and district personnel assist in administration of the area. People in the State have generally accepted that this kind of a management makes sense. Much of this credit for the successful operation is due to Wm. Leach, Sr., Land Management chief, and H. R. "Bud" Morgan, commissioner of the North Dakota Game and Fish Commission.

Public interest in the recreational and agricultural resources of the area are evidenced by the present leasing program and future plans for the area. This year, the Boy Scouts will hold their Annual Scout Camp for the Missouri Valley Council in their assigned area at Heart Butte Reservoir. Four-H groups from southwestern counties plan to build a clubhouse on their site. The Reverend Tolte plans a boys' camp in the organized camping area. Various local organizations, like Rod and Gun Clubs and similar organizations from the adjacent communities are planning lodges and clubhouses of their own. The Game and Fish Department has found it necessary to make private cabin sites available in three separate areas, two on the north side of the reservoir, and one on the south side. A day-use area, equipped with parking facilities, a well, pit toilets, and garbage disposal has been provided. More than 400 applications for private cabins have been filed. Last year about 60 lots were leased and about 10 cabins were built, and many more are planned this year. Leases from agricultural lands, boating and club site concessions brought in several thousand dollars which will be used to improve roads, provide more facilities such as toilets, boat docks, fences, garbage cans, fire grates, picnic tables and maintenance of the tree plantings. County Commissioners in Grant County have assisted by doing road work while their heavy equipment was in the vicinity.

Approximately 2,000 people were on hand at the reservoir when fishing season opened on May 16, 1954.

Fishing and boating are important interests of the visitors to the reservoir. Picnicking seems to be most popular in the new area. Swimming is popular at some locations. Ice skating is popular with some of the younger set during some winters when snowfall is light and the lake is frozen smoothly.

The game and fish department has planted about 3 million northern pike, 400,000 walleyed pike, 30,000 large mouth bass, and 15,000 bluegills in the reservoir. It was open to fishing of all species in 1954. Not to be overlooked as one of the most significant possibilities for the outdoor enthusiast is the migratory water fowl and upland hunting which are so popular in the Dakotas. The reservoir lies in an area famous for its abundances of Chinese Ring-Neck pheasants, sharptailed grouse and Hungarian partridge. Migratory waterfowl have already started to use the lake as a resting area on their annual migrations. In 1952, game officials estimated 40,000 ducks were present there during the peak of the fall flight. Last year the local nimrods managed to get their share of the fine flocks of Canadian geese which stopped and were feeding in surrounding grain fields. As the years go by it is expected that the Heart Butte Reservoir area will become a sportsman's paradise.

# # #

Owyhee Project Works Transferred

Secretary of the Interior Douglas McKay and Reclamation Commissioner W. A. Dexheimer recently announced that the water users on the Owyhee Project (Oregon-Idaho) were scheduled to take over and manage the remaining irrigation works on that project. These include the Owyhee Dam, the initial part of the main canal, related service transmission and telephone lines, operating roads, buildings and facilities.

This is in keeping with the water development policy of the Bureau of Reclamation, i. e., to transfer irrigation facilities to the water users as soon as they are able to assume responsibility for operation of the works.

All other features of the project were transferred to the water users to manage on January 1, 1952. The project has been in operation since 1935 and has been managed by the Bureau of Reclamation while the area has been brought to full development. It consists of about 103,000 acres of land receiving a full water supply, and 13,800 acres of land receiving a supplemental water supply.

RECENT MAJOR CONTRACT AWARDS

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DS-4094	Missouri River Basin, N. Dak.	Apr. 23	1 230-kilovolt circuit breaker for Jamestown substation	Brown Boveri Corp., New York, N. Y.	$60,300
DS-4102	Davis Dam, Ariz.-Nev.	Apr. 19	1 30,000/40,000-kilovolt-ampere and 2 6,000/7,500-kilovolt-ampere autotransformers with current transformers and lighting arresters for Gila substation.	Industrie Elettriche di Legnano. Milan, Italy, c/o Legnano Electric Co., New York, N. Y.	187,504
DC-4103	Missouri River Basin, N. Dak.	Apr. 20	Additions and modifications for Bismarck and Jamestown substations, schedules 1 and 3.	Electrical Builders, Associated, Mayville, N. Dak.	180,456
DC-4113	Missouri River Basin, S. Dak.	Apr. 12	Construction of Oahe temporary substation and related transmission lines.	Brink and Lange, Redfield, S. Dak.	175,881
DC-4114	Fort Peck, Mont.	Apr. 8	Construction of 2 transmission line relocations along the existing Fort Peck-Great Falls 161-kilovolt transmission line in vicinities of Havre and Loma, Mont.	Barlow and Co., Denver, Colo.	87,855
DC-4116	Palisades, Idaho	Apr. 19	Construction of earthwork and structures for relocation of Idaho State Highway 29 (US 26), Indian Creek to the State Line, Palisades Reservoir.	Heald and Christler, Inc., Billings, Mont.	274,808
DC-4120	Central Valley, Calif.	May 4	Construction of Folsom-Elverta terminal switching facilities.	Foothill Electric Corp., Oakland, Calif.	139,539
DC-4122	Missouri River Basin, Kans.	Apr. 14	Construction of bridge for spillway channel crossing, and road approaches and bridge for Bow Creek Crossing, for relocation of county roads, Kirwin Dam and reservoir.	Rentlor Co., Inc., Grand Island, Nebr.	122,375
DC-4125	Dalton Gardens, Idaho	May 13	Construction of earthwork and structures for steel pipelines, remodeling pumping plant, and furnishing and erecting 150,000-gallon steel water reservoir for Dalton Gardens irrigation system.	Intermountain Co., Boise, Idaho.	205,615
DS-4128	Missouri River Basin, N. Dak., and S. Dak.	May 6	2 main control board extensions unmounted switchboard equipment, unmounted line protective and carrier-current control and auxiliary relays, and 6 carrier-current transmitter-receiver sets for Bismarck, Oahe, and Jamestown substations and Fort Randall powerplant.	General Electric Co., Denver, Colo.	41,188
DS-4131	Palisades, Idaho	Apr. 28	124 trashracks for outlet and power intake structures, Palisades Dam.	Herrick Iron Works, Oakland, Calif.	55,100
DC-4137	Central Valley, Calif.	May 12	Construction of earthwork, pipelines, and structures, including 11 pumping plants, for laterals 111.6E, 113.7E, 115.8E and 119.1E and sublaterals, Unit 3, Delano-Earlimart irrigation district, Friant-Kern canal distribution system.	United Concrete Pipe, Baldwin Park, Calif.	2,298,483
DS-4145	Central Valley, Calif.	Apr. 29	202 10-inch vertical flowmeters for unit 1, Delano-Earlimart irrigation district, Friant-Kern canal distribution system.	Ray C. Sparling Co., El Monte, Calif.	33,330
DC-4146	Missouri River Basin, S. Dak.	May 12	Constructing foundations and erecting steel towers for 204 miles of Big Bend-Granite Falls 230-kilovolt transmission line.	Lipsett, Inc., New York, N. Y.	1,930,516
DC-4166	Missouri River Basin, N. Dak.	May 13	Repair of Dickinson Dam spillway	Schultz and Lindsay Construction Co., Fargo, N. Dak.	131,436
100C-178	Minidoka, Idaho	Apr. 16	Drilling and casing 32 water supply wells, group 4	R. J. Strasser Drilling Co., Portland, Oreg.	110,110
100C-179	Palisades, Idaho	May 28	Clearing 4,442 acres of Palisades Reservoir site, part I	W. D. Zavalas, Oroville, Calif.	97,778
117C-231	Columbia Basin, Wash.	Apr. 12	Construction of 1 10-truck garage and an addition to office building at Mesa O&M headquarters.	Freigang Construction Co., Tacoma, Wash.	39,550
117C-235	do	do	Construction of earth and blended linings for East Low canal, station 2976+74.52 to 3493+20.	L. D. Shilling Co., Moses Lake, Wash.	77,989
200C-249	Central Valley, Calif.	Apr. 26	Construction of 7 miles of Folsom-Nimbus 115-kilovolt transmission line.	Slater Electric, Folsom, Calif.	84,799
200C-250	do	Apr. 21	Furnishing and installing water supply line for fish hatchery near Friant Dam.	Valley Engineers, Inc., Fresno, Calif.	53,248
604C-30	Missouri River Basin, Mont.	May 18	Placing concrete floor finish; and furnishing and installing doors and partitions, chain-link fence, and cattle guards for Canyon Ferry Dam, powerplant, and access road.	Eisenman, Seabrook and Elliott, Chula Vista, Calif.	39,452
617C-40	Riverton, Wyo.	Apr. 19	Construction of earthwork and structures for 10 miles of open and closed drains in North Portal area.	Hicks Construction Co., Riverton, Wyo.	69,048
701C-334	Missouri River Basin, Kans.	Apr. 27	Relocation of 18 miles of county and township roads at Kirwin reservoir.	Winslow Construction Co., Englewood, Colo.	159,305

WORK CURRENTLY SCHEDULED[1]

Project	Description of work or material
Boise, Idaho	Fencing and constructing sheet pile retaining wall and miscellaneous Government camp protective facilities at Arrowrock Dam, 26 miles east of Boise, Idaho.
Boulder Canyon, Nev.	1 oil-pressure, cabinet-type actuator governor for regulating speed of 1 145,000 horsepower, vertical-shaft hydraulic turbine for unit N-8, Hoover Power Plant.
Do	1 butterfly valve and controls and 1 turbine inlet pipe for unit N-8, Hoover Power Plant.
Central Valley, Calif.	Constructing about 35 miles of 12- to 42-inch concrete pipeline with asbestos cement pipe alternate in sizes from 12 to 24 inches, for units 2 and 3, Exeter Distribution System, near Exeter, Calif.
Do	80 8- by 12-inch gate valves for unit 3, Delano-Earlimart Irrigation District.
Do	3 traveling water screens for unit 3, Delano-Earlimart Irrigation District.
Colorado-Big Thompson, Colo.	Enlarging and rehabilitating Coal Ridge Section of the South Platte Supply Canal, 15 miles southeast of Longmont.
Do	Enlarging and rehabilitating Erie Section of the South Platte Supply Canal, 9 miles southeast of Longmont.
Columbia Basin, Wash.	Constructing 1.5 miles of 2-foot-bottom drainage ditches, 3 24-inch corrugated metal pipe culverts and concrete drops, 10 miles west of Eltopia.
Do	Constructing 3 stilling wells and a concrete block equipment building about 6 miles east of Soap Lake, Wash.
Do	Drilling about 25 observation wells varying in depth from 50 to 300 feet, between Pasco and Mesa.
Davis Dam, Ariz.	Constructing 19,500-kilovolt-ampere capacity Casa Grande Substation. Government will furnish structural steel and major electrical equipment, including 1 13.8- to 115-kilovolt, 3-phase, power transformer, about 65 miles northwest of Tucson.

[1] This listing shows bid calls planned through September 1954 and is subject to change.

WORK CURRENTLY SCHEDULED[1]—Continued

Project	Description of work or material
Davis Dam, Ariz.—Continued	Constructing additions to Maricopa Substation, about 80 miles northwest of Tucson. Government will furnish structural steel and major electrical equipment.
Do	1 autotransformer, 3-phase, 60-cycle, outdoor, 30,000/40,000 kilovolt-ampere, with a tertiary capable of suppressing harmonics and supplying an external load of 6,66/8,880 kilovolt-ampere, 154,000 volts (H.V.) to 69,000 volts (L.V.) and tertiary rated 4,000 volts, class OA/FA or OA/FOA, with taps, current transformers, and tank-mounted lightning arresters, and suitable for use in parallel with a similar autotransformer being furnished under Invitation DS-4102. To be installed at Gila Substation.
Do	Fabricated galvanized structural steel for bolted substation structures for Bouse Substation. Estimated weight: 50,000 pounds.
Do	Fabricated galvanized structural steel for additions to Gila Substation. Estimated weight: 150,000 pounds.
Davis Dam, Calif.	Installing 161-kilovolt facilities at Blythe and Knob Substations will consist of constructing concrete footings, erecting Government-furnished steel structures and installing Government-furnished electrical equipment including circuit breakers, switches, transformers, busses, and metering and control equipment. Blythe Substation is 5 miles west of Blythe, Calif., Knob Substation is in Imperial County, Calif., 8 miles west of Yuma, Ariz.
Deschutes, Oreg.	Repairing stilling basin for outlet works for Wickiup Dam, near Bend, Oreg., will include removal of damaged concrete from floor and bottom of walls and replacing with new concrete; placing of anchor bars in floor; and grinding of roughened surfaces.
Do	Modification of check and wasteway to provide for the installation of radial gates at Crooked River Crossing, North Unit, Main Canal. 3 miles east of Terrebone, Oreg.
Eden, Wyo	Constructing 10 mils of 25 to 120 cubic feet per second laterals, and 3.5 miles of 6 to 20 cubic feet per second sublaterals north and west of Farson, Wyo.
Fort Peck, Mont.	Constructing 8,000-kilovolt-ampere, 115/69/12.5-kilovolt O'Fallon Creek Substation near Fallon, Mont., will require constructing foundations, furnishing and erecting a small, prefabricated-type service building, furnishing and erecting structural steel, and installing electrical equipment, major items of which will be furnished by the Government; and furnishing all materials for and constructing about 2 miles of 3-phase, wood-pole, H-frame 69-kilovolt transmission line.
Middle Rio Grande, N. Mex.	Clearing, cleaning and rectifying about 45 miles of existing drains and constructing about 0.75 mile of new drain. Work will include furnishing and laying 36- and 48-inch corrugated metal pipe or precast concrete pipe culverts, near Socorro, N. Mex.
Do	Rehabilitating Isleta Diversion Dam will include construction of new concrete base slab topping course; upstream apron with piling cutoff; repair of gate seals for 30 radial gates; raising deck of operating bridge; slabs, 14 spans at 20 feet each; replacement of handrail; replacement of sluiceway gate face plates and seals, 12 miles east of Albuquerque near Isleta, N. Mex.
Do	Rehabilitation of El Vado Dam in north central New Mexico will include rehabilitation of existing spillway and outlet works; excavation for emergency spillway and excavation for channel downstream from dam; removal of existing concrete structure; construction of wire mesh canopy; and cleaning and painting steel face of dam.
Minidoka, Idaho	Earthwork and structures for group 3 laterals 7 to 13 miles northwest of Rupert, Idaho.
Do	4 electric-motor-driven centrifugal-type pumping units each with a capacity of 60 cubic feet per second and a total head of 163 feet for unit A pumping plant.
Missouri River Basin, Nebr.	Constructing Bridgeport Substation will consist of constructing concrete foundations, furnishing and erecting structural steel, and installing and connecting all Government-furnished electrical equipment. Near Bridgeport, Nebr. on U. S. Highway No. 26.
Missouri River Basin, S. Dak.	Stringing conductors and overhead ground wires on single-circuit 230-kilovolt, 60-cycle, steel towers now being erected under Bureau of Reclamation Specifications No. DC-4081, for Jamestown-Fargo transmission line. The line is approximately 83 miles long. All materials to be furnished by contractor. The conductor will be 954,000-circular mil ACSR and the overhead ground wire will be 0.5-inch galvanized steel strand.
Do	Constructing 12.47-kilovolt addition to Valley City Substation near Valley City, N. Dak. Government will furnish major items of electrical equipment.
Do	Drilling 6 irrigation supply wells south of Jamestown N. Dak., including installation of casing and screens.
Do	Constructing the 15,000-kilovolt-ampere Pierre Substation near Pierre, S. Dak., will involve constructing foundations, furnishing and erecting a small, prefabricated-type service building furnishing and erecting structural steel, and installing electrical equipment, major items of which will be furnished by the Government.
Do	Constructing third stage at Groton Substation, 20 miles east of Aberdeen, S. Dak., will involve installing Government-furnished electrical equipment including a 15,000-kilovolt-ampere, 3-phase power transformer, breakers, and switches; and constructing foundations, furnishing and erecting structural steel, and installing electrical wiring.
Do	Repairing siphon and lining main canal near siphon, Angostura Unit, Hot Springs, S. Dak.
Do	Relocating and graveling roads in Pactola Dam site area, near Rapid City, S. Dak.
Do	1 600-kilovolt-ampere, 3-phase, 4.16-kilovolt plus or minus 10 percent, regulating transformer; and 1 600-kilovolt-ampere, 3-phase, 7.2-kilovolt plus or minus 10 percent, step-voltage regulator for Pierre Substation.
Do	Main control boards and station service boards for Pierre Substation.
Missouri River Basin, S. Dak.-Wyo.	Moving a frame house from Keyhole Dam, north of Moorcroft, Wyo., to the Pactola Dam site and constructing a basement and garage, and connecting utilities, west of Rapid City, S. Dak.
Missouri River Basin, Wyo.	Constructing about 5 miles of gravel-surfaced access roads at Glendo Reservoir near Glendo, Wyo.
Do	3 34.5-kilovolt circuit breakers for Basin Substation.
Do	1 115-kilovolt air switch, manually gang-operated, with automatic high-speed grounding blades; 2 115-kilovolt air switches, manually gang-operated, with grounding blades; 18 34.5-kilovolt air switches, hook operated; and 9 34.5-kilovolt air switches with grounding blades, hook-operated, for Basin Substation.
Do	2 34.5-kilovolt potential transformers and 6 34.5-kilovolt current transformers for Basin Substation.
Do	Main control board, a-c distribution panel, supervisory control equipment, and battery charger for Basin Substation.
Palisades, Idaho	2 96-inch ring follower gates and hoists for outlet works at Palisades Dam. Estimated weight: 250,000 pounds.
Do	Controls for 96-inch ring-follower and outlet gates at Palisades Dam.
Do	1 bulkhead gate and lifting beam for outlet works at Monticello Dam.
Do	1 12,000- to 480-volt, 3-phase, 60-cycle, double-ended, 1,000-kilovolt-ampere each end, unit substation, for Palisades Power Plant.
Weber Basin, Utah.	Construction of Gateway Canal, Wasteway, and Power Plant Headworks will include 7 11-foot concrete siphons totaling 2,500 feet in length; 6 miles of concrete canal lining; 1 mile of earth canal lining; canal structures; crossing structures; side channel spillway: and installation of radial gates and hoists. Southeast of Ogden, Utah.
Yakima, Wash	1 ice sluice gate for wasteway and 1 flap gate for pump discharge line at Chandler Power and Pumping Plant. Estimated weight: 13,800 pounds.

[1] This listing shows bid calls planned through September 1954 and is subject to change.

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The Reclamation Era

November 1954

IN THIS ISSUE:

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IN THIS ISSUE . . .

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J. J. McCARTHY, Editor

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OUR FRONT COVER

30 Years Ago in the ERA

Irrigation is the art whereby the deficiency in the natural rainfall, whether large or small, is supplied by water, artificially added, so that regular, abundant crops may be obtained.

Irrigation is and always should be supplementary to the rainfall. Consequently, the first big irrigation problem is to conserve the rainfall in the soil for crop use, so that the available irrigation water may be made to cover as much ground as possible. The beginning of irrigation wisdom is the conservation of the natural precipitation for the use of crops.

From "PRINCIPLES OF IRRIGATION PRACTICE"

by Dr. JOHN A. WIDTSOE, *Member of the Committee of Special Advisers on Reclamation.*

ERRATA SHEET

The by-lines for the articles "THE CONCEPTION AND GROWTH OF THE SACRAMENTO VALLEY CANALS" and "TACKLING TECOLOTE" on pages 81 and 85 in this issue have been transposed.

"SACRAMENTO VALLEY CANALS" was authored jointly by R. K. Durant, Construction Engineer, Sacramento Canals Unit, Region 2, and W. W. Speer, Personnel Assistant, Sacramento Canals Unit, Region 2. "TACKLING TECOLOTE" was authored by Emmett R. Crocker, Project Manager, Cachuma Project, Region 2.

The President Views Reclamation Projects in Five States

President Eisenhower took time out on Saturday, September 4, and made a 1500-mile air tour of existing and potential Reclamation's irrigation and multiple-purpose projects in five Western States of Colorado, Wyoming, Nevada, Kansas, and Utah.

The Presidential plane *Columbine* convoyed by special aircraft with newsmen aboard put down at three Reclamation centers for half-hour stops. Brief speeches were made by the President to large crowds that had gathered to greet him enthusiastically at Grand Junction, Colo.; Casper, Wyo.; and McCook, Nebr.

The President avoided reference to the fall Congressional campaign for Senate and House seats in the three latter States. However, he emphasized the philosophy of his administration for local, rather than national, initiative, a maximum of private enterprise, and partnership with Federal, State, and local participation.

Typical of his folksy off-the-cuff talks at the three stops were his remarks at Grand Junction, where he disclaimed a political flavor to the tour, saying:

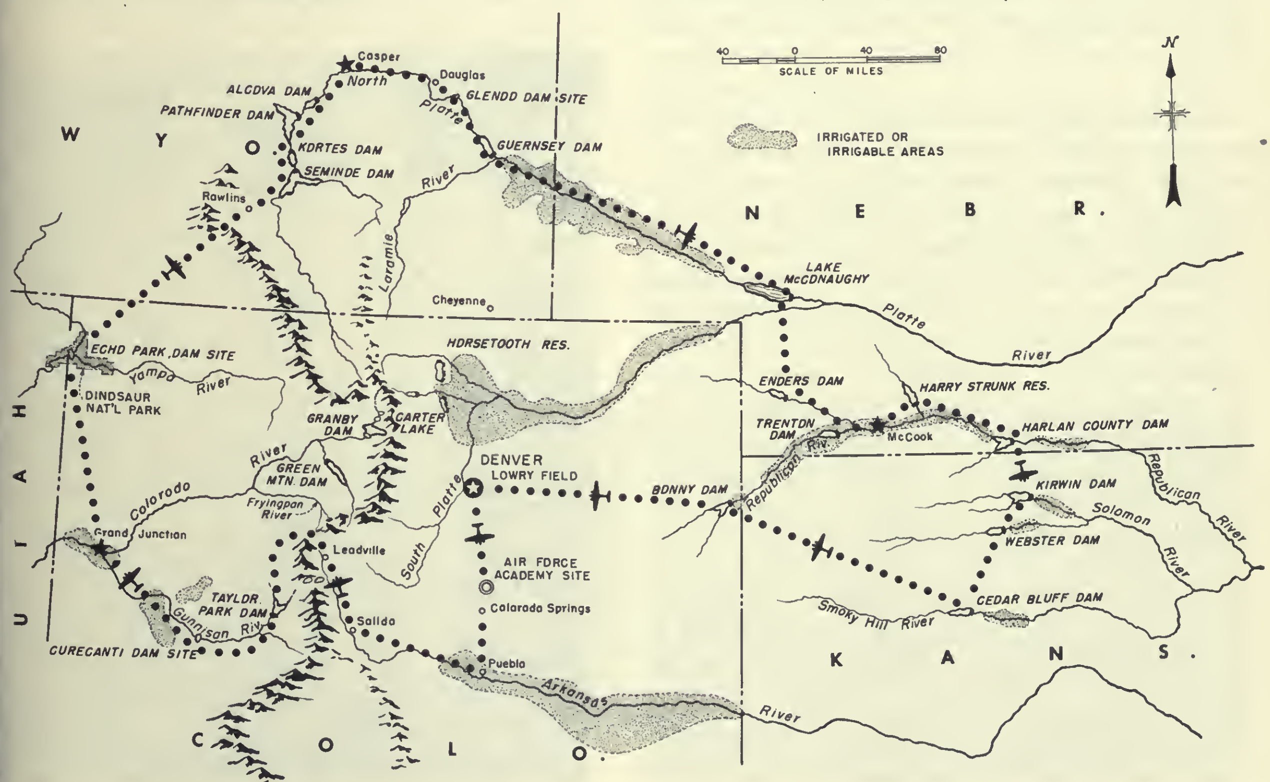
"* * * *I never get over being astonished when I look out the porthole of my plane and see a crowd gathering when I was traveling for some purpose other than what is called 'politicking.'* "

Also at Grand Junction, he set the tone of subsequent talks during the day as follows:

"* * * *This is for me, a trip to learn something. I am not out today to do any informing on my own, I am trying to absorb.* * * *

"*We are just trying to learn what it is that we can do, down in Washington, to be helpful in this great job that our citizens are doing in reclamation, in developing the resources of our country.*

"*We do not, as we see it, want to be the great bosses of America. We want to be the servants, the agent that will help our people make for themselves the happiest possible life.*



SINGING the NATIONAL ANTHEM are r. to l.: Governor Dan Thornton, President Eisenhower, Secretary McKay, Commissioner Dexheimer, Regional Director Larson, Congressman Aspinall, and Royden Girling, President of the North Fork Water Conservancy District. *Photo by Midwest Photo Service.*

President Eisenhower tells the audience that he is here to learn about irrigation. "This is for me, a trip to learn something. I am not out today to do any informing on my own, I am trying to absorb." *Photo by B. J. McCleneghan.*

"*When that calls for Federal direction, or engineering skill or finances—all right, let's put it in and do it cheerfuly, quickly and promptly. But let's not make Washington the master of any free American, either through unnecessary direct intervention in his business, or through the indirect method of getting control of all of the power and the resources that he needs in order to make a living.*"

Accompanying the President on the tour were Secretary of the Interior, Douglas McKay; Secretary of Agriculture, Ezra Taft Benson; W. A. Dexheimer, Commissioner of Reclamation; R. J. Walter, Jr., Director, Region 7, Bureau of Reclamation, Denver; T. A. Stephens, Appointment Secretary to the President; James C. Hagerty, Press Secretary to the President; Dr. Ivan D. Wood, Extension Agricultural Engineer-Irrigation, Department of Agriculture, Denver; Donald E. Clark, Regional Forester, United States Forest Service, Region II, Denver; Don F. Martin, Field Liaison Officer, Region 7, Bureau of Reclamation, Denver; Dan Thornton, Governor of Colorado; Harold Christy, Director of Water Development Association of Southeastern Colorado (Denver to Grand Junction); John R. Riter, Chief Development Engineer, Bureau of Reclamation(Denver to Casper); E. O. Larson, Director, Region 4, Bureau of Reclamation, Salt Lake City, (Grand Junction to Casper); Harry W. Bashore, Mitchell, Nebraska, former Commissioner of Reclamation (Casper to McCook); John N. Spencer, Regional

Continued on page 90

PRESIDENT EISENHOWER and COMMISSIONER DEXHEIMER at LOWRY AIR FIELD. *Photo by A/2c James Leisy, Wing Headquarters, Lowry Air Force Base, Denver, Colo.*

This article was adapted for the *Reclamation Era* by Mr. Paul D. Olejar, Program Services and Special Reports Branch, U. S. Department of Agriculture, from a speech by Dr. Shaw before the National Reclamation Association at Reno, Nev., in October 1953.

MAKING MORE OF IRRIGATION

Photo by Foldenauer, U. S. Dept. of Agriculture

by DR. BYRON T. SHAW, Administrator, Agricultural Research Service, U. S. Department of Agriculture

We know that without irrigation, the West as it is today would not exist. Impounded and controlled waters are the keystone in the economy of the West, which has 60 percent of the land area of the United States but only 25 percent of the fresh water supply.

Irrigation use of water was estimated in 1950 to be about 270,000 acre-feet a day. Since then, the President's Materials Policy Commission has estimated the maximum quantity of western water that will be economically used for irrigation probably is about 337,000 acre-feet a day. If this estimate is correct, it means we must greatly increase efforts to make the most of our irrigation resources. The needs created by increasing population show why.

Between 1940 and 1950 the Pacific Coast States showed a 48-percent increase in population, far above the national rate. The phenomenal growth is continuing. In fact, the population of the entire United States is increasing at a much faster rate than anticipated.

Just a few years ago, many people thought a population of 190 million in the United States by 1975 was a rather optimistic forecast. Today, the chances appear reasonably good we will reach that point before 1965.

Nutrition needs of 190 million people, if they are to have as good diets as we enjoy today, would require roughly a 30-percent increase over present farm production.

To obtain such an increase, if we continue to produce as much to the acre as we did in 1950, we would need 115 million acres more of cropland than we now have in cultivation. This estimate includes the equivalent, expressed in acres of cropland, of grazing land and pasture which supports our livestock production.

Prospects for new agricultural land are limited. The President's Water Resources Policy Commis-

BEFORE AND AFTER—Barren ground above marked site of Moses Lake Development Farm in 1946. At right is the same area in 1948 after development. Photos by H. E. Foss.

sion in 1950 estimated that drainage and irrigation projects under way or planned could provide the equivalent of 30 million acres of new cropland by 1975. Of this total, projected reclamation in the West was estimated to add 6 million irrigated acres, or actually the equivalent of 9 million acres, as 1 acre of irrigated land is deemed equal in productivity to 1½ acres of average cropland.

But the need will be 115 million acres. How, then, can it be met?

Several things can be done, of course, but inevitably we turn to research and technology. We must get more from each acre of land that is available. We may have to obtain about 60 percent of the additional food we will need in 1965 by making our presently available land produce better.

This will not be easy. We already have made tremendous gains. The achievements of research and technology in farming since 1940 are as if 5 million acres of cropland had been added to our agriculture each year. This rate is good, but it won't be enough in the future. At the present rate of population increase, we must add the productive equivalent of 7½ to 8 million acres of cropland each year through science and technology.

Intensification of production on lands now under irrigation—already comparatively high producers—is not only an opportunity but a necessity. And it calls for an adequate program of research.

The problem is not only one of having irrigation water, but also of managing it correctly and of developing the systems of soil and water management which would allow maximum yields without depleting soil productivity. There are many areas which have sufficient water but are not producing agricultural crops economically. In fact, some of our irrigated land has too much water.

What are the problems in irrigation agriculture which need to be solved by agriculture research?

Certainly one is that of using irrigation water more efficiently. Experts estimate the efficiency of most farmers is probably 35 to 55 percent, with very few going above 50 percent. Yet there is no valid reason why 80 percent or better efficiency might not be obtained if we had an adequate research program to get the facts.

What about water losses from canals and laterals? Bureau of Reclamation figures show that about 25 percent of the water was lost through seepage from irrigation projects in 1949. It was enough water to supply an additional million acres of land. We must save that water.

What about acre yields? We know that there is a tremendous difference in the yields received. For example, during the past 22 years, per acre yields on experimental plots at our Huntley, Mont., field station averaged 50 to 168 percent above those of farmers in the Huntley district.

A study at the Scottsbluff station in Nebraska also showed how much yields vary among farmers. In 1950 the average yields of corn on 5 nearby irrigation districts ranged between 27 bushels to 45 bushels. For sugar beets, farmers on one project obtained 13 tons, on another 16 tons.

Why do some farmers obtain higher yields than others? Is it a matter of soil fertility, available moisture? Is time of planting important, the variety, or the use of hybrids?

The truth is that we too often don't know. We don't know fully the reasons why. We need research to find out. Of course we do know the general factors that tend to increase yields. Good management is one. Experiments at Yuma, Ariz., show what can be done by better management of good fertilizer practice and good irrigation in getting better crops. Working with alfalfa, researchers found that heavy fertilization and frequent light irrigations produced 13 tons of hay to the acre, almost twice as much as when low rates of fertilization and normal irrigation were used. The efficiency of water in producing a ton of hay was increased almost 100 percent. The point is that maximum production is obtained only by the proper combination of good practices in every operation that affects crop production.

Here's another question: How is high fertilizer use affecting established concepts on rotations?

COLUMBIA BASIN BEETS form stockpiles about 32 feet deep, 200 feet wide, and ¼ mile long. *Photo by J. D. Roderick.*

Experimental irrigated plots at Scottsbluff that had been planted to corn year after year were producing practically no crop by 1950. On other plots yields were high because good rotations were being used.

It was decided to see what heavy fertilization would do for corn yields on those plots which were in continuous corn. 200 pounds of nitrogen fertilizer per acre were applied. You've guessed it. Corn yields were as high as on the best rotations, exceeding 100 bushels.

These experiments only underscore the overall problems we face in meeting agricultural needs of our increasing population in the years to come. The challenge is not confined to water efficiency and fertilizer and moisture relationships. Other problems may be equally pressing.

More than a million acres are now abandoned because of salinity and alkali. Can such lands be reclaimed? Other lands once bountiful are now producing meagerly. Can they be restored? Research shows it is possible. In Utah, for example, 40 bushels of wheat per acre were produced on land once abandoned because of salinity. Here's a real research job to find the most economical ways of restoring such lands everywhere.

The more we know the better our chances. In expanding the irrigated West, perhaps one of the most significant research advances in recent years has been the establishment of pilot demonstration farms in new areas.

It is a particular pleasure to me that I was one of the small group that launched the idea of pilot farms in the Columbia River Basin back in 1944—a suggestion which eventually was realized in the Moses Lake development farm. The best combinations of practices are being proved under actual farm conditions, and much of the guesswork is eliminated long before settlers arrive. Such pilot farms are now in operation in other areas.

In thinking about the agricultural future of the United States, we must bear in mind that reclamation is resource development that puts water, land, minerals, and power to use for today, for tomorrow, and for posterity.

To make the most of irrigation, we must see every tool that is available. Science certainly is one of the most important.

Science is a powerful servant. But it takes hard and intelligent work by skilled research scientists to make it so. Improving farm production and marketing is the business of research. This is our business; we dare not let it fail. ###

Secretary McKAY and Commissioner DEXHEIMER to Address NRA Convention

The 23d Annual Convention of the National Reclamation Association will open at the Hotel Multnomah, Portland, Oreg., on Monday, November 8, at 2 p. m., and continue through November 9 and 10. Preliminary plans for the convention have been developed by Secretary-Manager William E. Welsh, who left Washington August 24 to confer with President Petrus Peterson at Lincoln, Nebr., and other officers and directors of the Association in various western States. Indications are that the attendance will be large and the speakers will include men of national and international reputation.

At the opening session on November 8, the principal speaker will be Secretary of the Interior Douglas McKay, former Governor of Oregon. This address will be followed by the transaction of Association business, including reports from the President of the NRA and other officials.

Tuesday's program includes an address by R. A. Work, of the Soil Conservation Service, who is in charge of snow surveys in the 17 western States. A grass-roots discussion will follow, with the principal speakers being representatives of irrigation districts and reclamation developments in the West. Among the speakers will be Ed Lage, of Hood River, Oreg.; and Elmo Chase, of Eugene, Oreg., who will discuss the Willamette Valley program.

The speaker at the luncheon on Tuesday will be Governor Sigurd Anderson, of South Dakota. In the afternoon, Regional Director H. T. Nelson, Bureau of Reclamation, Boise, Idaho, will outline the Reclamation program in the Pacific Northwest.

At the annual banquet Tuesday night, Governor Patterson of Oregon will be the principal speaker.

Wednesday's program will include addresses by Dr. R. G. Gustavson, former Chancellor of the University of Nebraska, and now President of "Resources for the Future." Other speakers that forenoon will be Maj. Gen. S. D. Sturgis, Chief of Engineers, Department of the Army, and Wilbur A. Dexheimer, Commissioner, Bureau of Reclamation. Other speakers on Wednesday will include Congressman A. L. Miller, of Nebraska, Chairman of the House Committee on Interior and Insular Affairs.

Land Can Be Kept In Production

By D. M. ARCHIBALD, Agriculturist, Cody, Wyo.

The Deaver Irrigation District which operates the Frannie Division of the Shoshone Project has been faced with a serious land problem for a number of years. The project was designed and built to serve 28,000 acres, but due to various causes the irrigated acreage has slowly declined to something like one-half of this amount. The remaining irrigated acreage is so scattered that only a very few of the laterals could be abandoned and the remaining lands are saddled with the cost of operating and maintaining a system designed to serve much more land than is now irrigated. This means that every effort must be made to keep every available acre in production or the operation and maintenance costs could become prohibitive.

This was recognized in 1949 when the entire situation was reviewed by the Bureau of Reclamation and the irrigation district, and plans were drawn up to improve the situation as much as possible. After careful consideration it was decided that a Land Rehabilitation Program was highly desirable, and in 1950 a program was started. Several pieces of equipment, including a ¾ yard dragline, crawler tractor, scraper, and ripper were purchased by the irrigation district. This equipment is used for land improvement work. Actual costs covering operators, fuel, and repairs is all that is charged the landowner. There is no depreciation charge so a sizable saving is made to the landowner.

In order to improve his land, the landowner makes an application to the irrigation district for the land improvement work stating the type of work wanted, such as drainage, leveling, etc., and the approximate acreage involved. If any of the land has been out of production he also makes an application for water and agrees to pay operation and maintenance charges.

Charles Burris, the manager of the irrigation district, reviews the application and determines whether or not water can be delivered to the land at a reasonable cost. It may involve rehabilitation of several miles of abandoned lateral, or it may not involve any added construction. If his review is favorable he then refers the application to the Shoshone project superintendent, Robert Fagerberg, at Powell, Wyo. Soil Conservation Service and Bureau of Reclamation personnel then make the necessary studies to determine if the proposed work will benefit the land, what the approximate costs will be, etc. A committee consisting of representatives from the Bureau of Reclamation, Deaver Irrigation District Board, Soil Conservation Service, and the manager of the irrigation district, then reviews the work with the landowner and recommends what is to be done.

The Soil Conservation Service certifies the program to the Agricultural Stabilization and Conservation Committee. If it is an approved conservation practice, and if the farmer is eligible the ASC will make payments to assist in the program.

Farmers are enthusiastic about the program, for as one said, "I have been able to improve my farm and drain land that I couldn't afford to develop without this program."

Because of the large amount of land that is seeped or has a high water table, an efficient and workable drainage program is one of the big jobs in the land rehabilitation work.

Early in the history of the project most of the trunk drains were constructed so that drain outlets could ordinarily be reached within reasonable distance. However, even with all of the drainage construction that has been done, there are many relatively small areas that need draining. Some are found in the middle of an otherwise good field and are usually spreading slowly to other good land.

Since the fall of 1950, 61,000 feet of new open drains and 7,000 feet of tile drains have been built and 17,000 feet of drains have been cleaned and deepened. While it is too early to properly evaluate all the work, the drains seem to be effective and are benefiting the surrounding land. In fact, some of the land has been brought back into production 1 year after draining.

Prior to 1953 all of the drains were open type as the general feeling of the farmers was that tile drains would not function properly because of the heavy tight soils found in some areas or unstable

soils found in others. While open drains will effectively drain the land there are several objections to them.

1. Large acreages of productive land are left idle and wasted because of drain banks—roughly 10 acres per mile of drain.

2. Noxious and other weeds grow on the spoil bank and are hard to control.

3. Open drains are difficult and expensive to maintain. They slough and lose effective depth, weeds grow in the bottom, and gradually fill the drain.

4. There is a tendency to place open drains along fences rather than in their most effective location to keep from cutting up fields.

To demonstrate the relative merits of tile drainage, four locations were selected and tile drains were installed under the rehabilitation program. The tile was gravel packed. Two of the drains were at once effective, and the other two were slower to take effect due to soil conditions, but the affected land is showing gradual improvement. As a result, several farmers have installed tile drains on their own farms and are well pleased with the results. Others have shown interest in the program and plan to install tile drainage in the immediate future.

Due to the rough topography and numerous small fields, leveling is of great value in the rehabilitation program. Rough topography makes a complex irrigation pattern, that requires an excessive amount of water and extra labor time in irrigation. This not only raises the cost of producing a crop but lowers yields and increases the drainage and fertility problems. Over 800 acres of land have been leveled since the program began. Some has been light leveling, but a sizeable acreage has been heavy leveling to correct unproductive, rough sagebrush areas into good producing land.

The land rehabilitation program is an excellent program and is popular with all concerned. The

Below: Outlet for completed tile drain. Top right: Victor Christensen, member of Deaver Board, standing in a field becoming waterlogged and going out of production. Immediate right: Charles Burris, Buford Hendricks, and Walter Sanders, officials of Deaver Board inspecting sugar beetfield largely out of production, last year, due to seepage. *All photos courtesy of the author.*

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landowner, irrigation district, Soil Conservation Service, and Bureau of Reclamation, all working together contribute something to it and in return each receives some benefits. The Deaver Irrigation District Board, which directs the activities of the Frannie Division of the Shoshone project, should be commended for its consistent work toward making the program a success. This board is composed of John Zwemer, President and Commissioner of District 3; Buford L. Hendricks, Vice-President and Commissioner of District 2; W. Sanders, Secretary; Ed Lorenz, Commissioner of District 1, Squire Dillon, Commissioner of District 4; and Victor Christensen, Commissioner of District 5. Land is being reclaimed and put into production for $30 to $100 per acre, or at a fraction of the cost of purchasing good land or for developing new land on any proposed Reclamation unit in the area.

As these scattered tracts are brought back into production the irrigated area becomes continuous, and unsightly spots that harbor noxious weeds and predatory animals are eliminated. The landowner now knows that the seeped areas can be drained and will not necessarily spread and include additional acreage. The entire project is taking on a new appearance as the confidence and pride of the owner in his unit and community is justifiably increased.

Estimates show that since the beginning of this land rehabilitation program about 1,000 acres of unproductive land have been improved. While not all of this land is in high production at the present time, it is improving and will soon be in good production. This is equivalent to six or seven new farm units.

Similar programs are needed on nearly every irrigation project in the West. Any program that will increase the irrigable acreage and improve the quality of the land is a good will program as it helps the entire project as well as the individual landowner. ###

YOUR MAGAZINE

Are there particular types of articles which you would like to see in the Era that we have not printed to date? If so, please let us know, and we shall do our best to comply with your wishes.

PRESIDENT OUTLINES WATER CONSERVATION PROGRAM

In a recent statement announcing signing of law amending Water Facilities Act, President Eisenhower said, in part:

"This is one of three legislative actions taken by the 83d Congress which give important new strength to our national efforts to conserve the vital water and soil resources of the United States . . .

"This legislation is significant because it gives new stimulus to local initiative and establishes for the first time a nationwide program of conservation practices based on the concept that farms, streams, forests and towns are all interrelated parts of a watershed. It recognizes in practical terms that the upstream part of the watershed, as well as the downstream part, must be taken into our plans if we are to have the water we vitally need and if we are to solve with maximum effectiveness three of our most challenging problems—soil erosion, floods and drought."

The President explained that the other two measures were the Watershed Protection and Flood Prevention Act and the revision of the internal revenue laws which give farmers new tax advantages for soil conservation expenditures.

The two watershed laws are administered by the Soil Conservation Service, Department of Agriculture, and the tax provisions by the Internal Revenue Bureau of the Treasury Department.

"Another significant contribution of the watershed legislation is that it gives new force and emphasis to local leadership . . . These programs will be planned only at the instance of local people . . . They will be initiated only when local people have demonstrated their willingness and ability to share equitably in the cost and to assume responsibility for direction and maintenance of the work.

"The watershed and water development programs will also encourage a new and improved means of local-State-Federal teamwork."

"Floodwater retarding dams . . . represent measures which individuals cannot be expected to install by themselves, and which may properly require State or even Federal aid because their benefits extend beyond the local community.

"The Federal Government also has a major role in providing technical, research, financial, and educational assistance."

The Conception and Growth of the Sacramento Valley Canals

By EMMETT R. CROCKER, Project Manager, Cachuma Project

When former Under Secretary of the Interior Ralph Tudor authorized the Bureau on August 4, 1954, to prepare specifications for the first 7½ miles of the Corning Canal, it was the beginning of the realization of a 60-year old dream of many old timers. For the Corning Canal is one of the three units that comprise the Sacramento Canals Unit of the Central Valley project. The other two units are the Chico Canal and the Tehama-Colusa Canal.

These canals will lie on both sides of the Sacramento Valley in Northern California and will serve approximately 205,000 acres of tillable land in the counties of Tehama, Glenn, Colusa, Butte and Yolo. The geographical center of this area is about 65 miles south of Shasta Dam, key structure of the Central Valley project, and about 60 miles north of Sacramento.

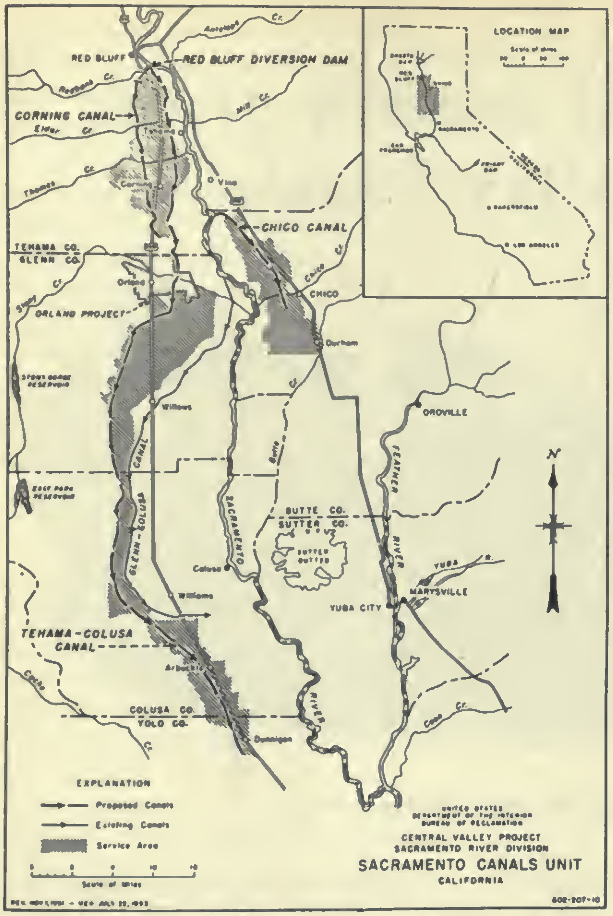
John Sutter, on establishing his Fort, now the city of Sacramento, in 1839, planted the seed out of which grew the rich and prosperous Sacramento Valley. The first sign of growth began when the Mexican Government granted huge tracts of land to individuals. Soon afterward miners, sheepmen, cattlemen and homesteaders followed by railroads and highways spread out over the remaining land.

The first fruitful results from the valley were hides and meats produced from large-scale cattle raising. Then gold was discovered in 1848, putting greater demands on the valley for sustenance.

The great influx of people caused the farmers to turn to more diversified types of farming than dry-land farming and cattle raising, thus establishing small-scale irrigation farming.

Irrigation proved so successful that the State legislature took cognizance of its problems along with those of navigation and drainage and ordered the surveyor general, in 1850, to make a study. Again in 1866, the State legislature authorized a study for a canal to extend from the Sacramento River through Colusa, Yolo, and Solano counties. Then in 1873, a commission headed by Lt. Col. B. S. Alexander studied the Sacramento and San Joaquin Rivers. In a report to President Grant in 1874, the Alexander Commission projected an idea of a system of canals which included the idea of a Sacramento-to-San Joaquin water exchange.

Five years later William H. Hall, State engi-



THE SACRAMENTO CANALS UNIT PLAN

neer, received $100,000 from the State for studies to provide a system of irrigation, to improve navigation and to promote drainage.

Around the turn of the century Dr. Elwood Mead, later Commissioner of Reclamation, made a study of California irrigation. And in 1902, the Bureau of Reclamation came in and made studies from 1902 to 1904 in cooperation with the State of California Division of Resources. The Bureau made additional studies in 1909 and 1925. But it was in 1919 that Col. Robert Bradford Marshall, of the USGS outlined his plan in a letter to Governor William Stephens, which proposed a series of storage reservoirs on the Sacramento River system and two large canals to carry water on both sides of the Sacramento Valley to the San Joaquin Valley. And it was from this plan that the Central Valley project took many of its basic ideas.

From 1920 to 1932 approximately 14 reports were made on water flow, drought conditions, flood control and irrigation problems, and by 1931 State Engineer Edward Hyatt compiled these reports into a "State Water Plan."

The continued growth of the valley and the success of irrigation made it necessary for the formation of water districts. And the Bureau, about 1910, built the Orland Irrigation project to service approximately 20,000 acres.

But this project and these districts were still not enough to meet all the water requirements. So the Bureau returned again in 1946. That year field surveys for the west-side gravity canal were partially completed and some information was gathered relative to costs, service areas, crops grown, and water requirements. During 1947 and early 1948 little progress was made because of limited funds. But in the latter part of 1948, investigative work on the Tehama-Colusa gravity canal and the Corning Canal was resumed.

But the Bureau was not the only one to take up the cause, for in November 1948, a group of spirited citizens of the four counties, Glenn, Colusa, Butte, and Tehama, knowing the historical background of these various investigations, plans and proposals, met at Corning and formed the Sacramento Valley Irrigation Committee. This committee has been very active and helpful to the farmers in answering questions and assisting in the formation of water districts (The *Reclamation Era*, July 1951).

In view of the mounting and intense public interest and the probability of legislation being enacted to authorize the canals, the Bureau of Reclamation established a field office at Red Bluff in 1952.

From the wealth of investigative material, plans and proposals and from additional investigations, the Bureau adopted the following plan:

Near Red Bluff will be constructed the Red Bluff Diversion Dam. From this dam, and on the west side of the river, are to be constructed the Corning Canal and the Tehama-Colusa Canal. The Corning Canal will extend approximately 26 miles south, and will consist of an electrically driven pumping plant to raise 500 cubic feet per second of water 55 feet from the reservoir behind the Red Bluff Diversion Dam into the canal.

The Tehama-Colusa Canal, extending to Yolo County, a distance of approximately 121 miles, will also be supplied water from the Red Bluff Diversion Dam.

On the east side of the valley will be the Chico

Continued on page 89

modern pioneers

Opening of Angostura district to limited irrigation farming may set a pattern for influx of "pioneers" into more arid areas.

Editor's Note: We are indebted to Messrs. W. J. and H. H. Allen, Publishers of The Dakota Farmer for the following article which appeared in the February 20 edition of their publication. We also wish to express our appreciation to them for obtaining the accompanying illustration for our use.

BIG DITCH that carries water from Angostura Reservoir to 28,500-acre Cheyenne River project. *International Harvester Photo.*

For most Dakotans, pioneering is, at best, a dim memory. No so for a group of young farmers in western South Dakota. Maybe what they are doing isn't exactly pioneering, but it is as good an example of it as you'll find in Dakota in 1954.

These farmers, mostly veterans, moved on their farms last spring. They came from South Dakota, from nearby States, and from other parts of the country. Most of the farms they moved onto were bare—with no buildings, wells, or improvements. Most of them were former dryland farmers—this land would be farmed under gravity irrigation. Purchase terms were almost as liberal as the terms given to the original pioneers—the homesteaders who settled Dakota.

Why did they make this move? It all got started when Congress passed the Case-Wheeler act, authorizing the development of irrigation projects in the Missouri River basin. One of these was the Angostura project, on the Cheyenne River in Fall River County.

The Angostura irrigation district stretches from the town of Hot Springs over into Custer County. It comprises 28,500 acres, 12,000 of them irrigable. In 1941, the Government bought up 77 percent of this acreage, planning to develop it for irrigation. World War II came along, though, and postponed the development of the region. After the war, work was resumed on the dam and on land development. The dam was finished in 1949.

PREPARED FOR SETTLERS

Then the work of subdividing the district into farm units began. The Soil Conservation Service was mainly responsible for this phase of the work. The Bureau of Reclamation built the canals and laterals to bring water to the farms. Then it was the Soil Conservation Service's job to get the individual farms ready for irrigation, by leveling the land and constructing drainage and distribution systems.

The first farm units were ready for occupancy in the fall of 1952. More were completed during 1953, and the remainder will be finished up in 1954. Each unit contains about 120 acres of irrigable land, and from 30 to 300 acres of nonirrigable land.

Each fall, the farm units that have been developed during the year are put up for sale. First preference is given to farmers who owned or rented land when the area was under dryland farming. After them, veteran farmers from other areas are next in line.

The deal is given publicity in South Dakota and other states before the deadline for applications. Applications are screened by a volunteer committee composed of farmers, businessmen, government personnel, and county agents from Custer and Fall River Counties. Applicants must be in good enough physical and financial condition to operate an irrigated farm. Those whose applications are rejected may appeal the rejection within ten days.

On the application, the veteran indicates the numbers of the farm units he desires, in order of preference. After all applications have been reviewed, a drawing is held. If an applicant's first choice has been awarded to someone else by the time his name is drawn, his second, third, or even twelfth choice may be available, and he may buy that.

The Soil Conservation Service appraises the land, considering the quality of the irrigable land and the improvements, if any, on the farm in arriving at a price. Productivity indexes are used, and prices are based on the 1939–44 average. The farms are sold with or without mineral rights, which cost $1.50 per acre extra.

Buyers are required to make a down payment of 5 percent on their farms. They may have 40 years to pay off the remainder, at 3 percent interest.

HOW THEY OPERATE

Thomas Mulachy, from Gordon, Nebr., is one of the farmers who moved to the project in the spring of 1953. Mr. Mulachy has 365 acres now, 13 of which are irrigated. He's a newcomer to irrigated farming, having operated a dryland farm in Nebraska previously.

Mr. Mulachy grows alfalfa, corn, oats, barley, and sugar beets on his irrigated acres. His dryland is in wheat and summer-fallow, and he has 60 head of cattle on 160 acres of dryland pasture.

There were some old buildings on his place when he moved in. Since then, he's built a house, drilled a well, moved in a shed, and put up 3 miles of fence. His future plans are for a barn, a machine shed, a chicken coop, and more fencing.

What does it cost to get started in irrigated farming? Between $25,000 and $30,000, Mr. Mulachy figures, plus the price of the farm itself. This includes $8,000–$10,000 for a house, about the same for other buildings, $3,000–$4,000 for fencing, and $12,000–$15,000 for machinery. The last figure would be higher, Mr. Mulachy told us, except for the fact that the sugar company rents farmers some equipment necessary in beet raising.

Sterling Mueksch, originally from Hay Springs, Nebr., was another former dryland farmer. He has 253 acres here; 106 irrigated, the rest in dryland pasture. Mr. Mueksch figures sugar beets are his best crop, although he's never grown them before.

PLACE OF HIS OWN

Mr. Meuksch became interested in irrigated farming after observing the Mirage Flats irrigation project, about 20 miles east of Chadron, Nebr. Irrigation looked like a good bet to erase the threat of dry years, and moving up here gave him a chance to own a place of his own.

Donald Peck, another former Nebraskan, was already familiar with irrigated farming and its problems when he moved onto the Angostura project. Previously, he had operated his father's irrigated farm at Mitchell, Nebr.

His land was bare when he moved onto it last spring. Since then, he's moved in an old building which he and his family use for a house.

Mr. Peck has 204 acres, 125 irrigated. He has no cattle right now, but was planning to winter some feeders.

Michael O'Day is one of the farmers who moved back into the Angostura district after having lived there when the area was in dry-land farming. Mr. O'Day used to grow wheat and corn on a 1,400-acre farm. His present farm is 286 acres, 121 of them irrigable.

Now, Mr. O'Day grows sugar beets and a complete crop rotation. He had 11 acres in sugar beets in 1953, to which he applied fertilizer twice. Although he's never seen sugar beets grown before this year, his yields were close to 15 tons an acre.

George Schmid, project supervisor with the Soil Conservation Service, and Floyd Haley, Fall River County agent, have been advising the farmers in the project. The whole thing's a chance at pioneering, Mr. Schmid told us, one of the few chances for young farmers to own their farms.

# # #

Riding to work in a "BATHTUB." These muck cars are filled with 84° F. water in which men ride through the hottest section of the tunnel. *Supreme Service photo*

TACKLING TECOLOTE

HOW RECLAMATION ENGINEERS COOLED A HOT AND TROUBLESOME TUNNEL

By R. K. DURANT and W. W. SPEER

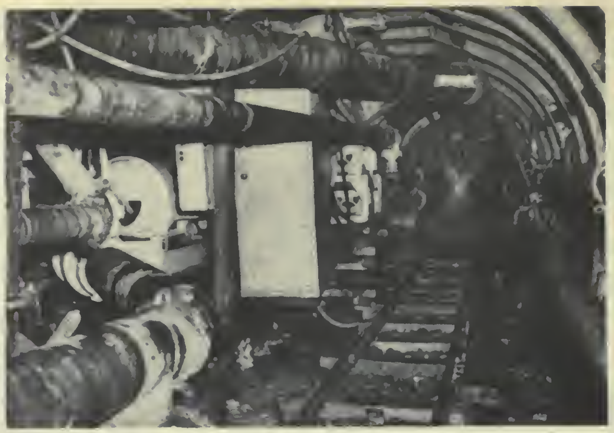
How tough can a tunnel get? Tecolote Tunnel on the Cachuma project, California has been variously described as the toughest tunnel ever undertaken, the wettest and the hottest hole ever dug into a mountain and even the rear entry to Hades.

Yet in 1950 when construction was started it appeared innocent enough. True, the 7-foot diameter, 6.4 mile length indicated a job of many months duration to the most optimistic and the small diameter was the occasion for some concern to those envisioning the ventilation and hauling problems during excavation and placement of the concrete lining. Some naturally apprehensive souls predicted great trouble with gas and water but even the most pessimistic did not envisage any abnormal temperatures.

Tecolote Tunnel is designed to convey water stored in Cachuma Reservoir on the Santa Ynez River through the rugged Santa Ynez Mountains to the fertile coastal strip laying between the mountains and the Pacific Ocean adjacent to and surrounding the city of Santa Barbara. Precipitation in this area is almost entirely confined to the so-called winter months and water is sorely needed to mature the great quantities of lemons, avocados, and walnuts which are produced so abundantly, as well as to supply the municipal and industrial requirements of the area.

For many months after construction was started the pessimists were somewhat discomfited by the excellent progress made on excavation, monthly advancement of each heading generally ranging from 800 to 1,000 feet. In the inlet leg of the tunnel no material sustained inflows of water were encountered, the total inflow after excavation of 14,919 feet being only about 300 gallons per minute. About 9,000 feet in from the inlet portal a minor infiltration of methane gas occurred. A mixture of air and gas which had collected in the top of the tunnel became ignited, resulting in more or less superficial burns on the faces of several workmen. Thereafter taps in the ventilating pipe were installed at all critical points and auxiliary fans provided to prevent gas from accumulating in explosive mixtures. At this point there was a decided change incident to two major faults or slippages of rock. Excavation progress thereafter was at a much reduced rate until it was discontinued 14,919 feet from the portal to permit the tunnel to be lined before rising water in Cachuma Reservoir would interrupt access through the portal.

Long reaches of innocent appearing rock developed swelling or squeezing characteristics, requiring the realinement of steel supports, replacement



of supports distorted by excessive pressures, installation of supports at more frequent intervals, and cross struts at the bottom.

No large sustained inflows of water occurred. Minor amounts collected with the result that the siltstone through which much of the inlet leg was excavated was churned into thin mud by traffic. A serious clean-up problem was involved in connection with the placement of concrete, particularly as the presence of the cross struts prevented the use of any type of mechanical equipment. This cleanup problem was effectively solved by partial removal of the mud and stabilization of the remainder by deposition of gravel.

In the outlet leg the first interruption occurred at a point about 7,500 feet from the outlet portal where the first significant amount of water was encountered. Here a concentrated inflow of about 1,250 gallons per minute was developed. At about this time the city of Santa Barbara and the Montecito County Water District were experiencing a severe water shortage. In the Montecito District very stringent water rationing regulations were in effect and in Santa Barbara wells were hastily developed. Arrangements were made for transportation of the water developed in the tunnel through the recently completed Goleta Section of the South Conduit to the westerly limits of Santa Barbara. The city and Montecito installed a booster pump and constructed a pipeline about a mile and a half in length introducing the water into the city system and by existing interconnection delivered it to Montecito. The excavation of the tunnel had been advanced another 3,500 feet, where an additional inflow of about 2,500 gallons per minute, was encountered. The combined inflows totaling about 3,750 gallons per minute relieved the overdraft on the city wells and permitted the relaxation of the restrictions on water use in the Montecito District.

It is interesting to note that there had been a gradual increase in rock and water temperatures from about 60° F. at the outlet portal to about 84° F. at the point 11,000 feet from the portal where the last mentioned water inflow was encountered. This rise in temperature was only about what could be accounted for by depth below the rising surface of the mountains.

The water inflow was encountered in the drill holes at about 300 pounds per square inch. These holes were in crushed rock and the water spurting carried with it several hundred cubic yards of rock into the tunnel, almost filling the hole a distance of about 200 feet. After conditions had become somewhat stabilized two attempts were made to control the water by construction of concrete bulkheads and injection of cement grout into the broken rock. The first attempt was unsuccessful; the high pressure water and grout found its way around the bulkhead through fissures in the rock. A second bulkhead further removed from the face of the excavation and located in more solid rock was apparently successful and some 3,800 sacks of cement were injected as grout into the rock and bulkhead area. It was found upon excavating that while the voids in the broken rock were generally filled with grout, the rock itself was too weak to withstand the water pressure and water in large quantities again flowed into the tunnel. The water in the broken rock rendered the face so unstable that it could not be advanced by conventional tunnelling methods. The problem was finally solved by excavating drifts parallel to and a short distance on each side

L. to R.—Main pump chamber, 11,500 feet from outlet portal where inflowing water has temperature of 84° F.; compressed air, cool water, ventilation, and water pipes plus power cables leave little headroom; more water as heading is advanced; water discharging from behind metal panning at lower left and right adds to an already tight situation. *All photos by Supreme Photo Service, Goleta, Calif.*

of the tunnel line in rock which proved to be somewhat more substantial and thus diverting the water from the tunnel face. By alternately advancing the drifts and the tunnel, the tunnel was successfully excavated through 200 feet of broken rock and heavy water inflow after which more competent rock containing less water was encountered. The water developed was near the capacity of the available unwatering equipment and since it appeared probable that additional water would be encountered, it was decided to place about 250 feet of extra thick lining to seal off this inflowing water before further advance was attempted. By constructing a large underdrain through which the water could flow freely, the lining was successfully placed. The underdrain was piped through the cutoff at the downstream end of this lining and a shutoff valve was provided which was closed after the lining had attained sufficient strength to withstand the external water pressure. Upon closing the valve the lining was found to be substantially watertight and forward advancement of the tunnel heading was resumed.

As the tunnel was advanced pilot holes were kept about 30 feet ahead of the heading for advance detection of water bearing seams. When presence of water in substantial quantities was indicated grout under pressures as high as 2,000 pounds per square inch was forced into the seams in the rock and by this means inflowing water was kept to a minimum. During this phase of construction the tunnel excavation was advanced about 2,500 feet. As this advanced the flow increased at the rate of about one gallon per minute for each foot. But more significant was the increase in the temperature of the water and the rock. Temperatures rose slowly at first and then more rapidly, reaching a maximum of 112° F. at the end of the 2,500 feet advance. At this time too, July 20, 1953, the total inflow was about 4,000 gallons per minute, which was the practical limit of the contractor's unwatering facilities and incidently the available power supply. Ventilation also became a problem as the air forced into the tunnel soon attained the temperature of the inflowing water and a humidity of about 100 percent. Under these conditions it became practically impossible to keep men on the job. On July 21, 1953, the contractor notified the contracting officer that it was no longer able to cope with the situation and that work was being suspended.

Plans and expedients for completing the tunnel were being explored and studied. A board of consulting engineers, suggested several approaches, including the employment of the most competent ventilation experts obtainable. The board's basic conclusion was that the tunnel could only be completed by the employment of "heroic measures." Studies made by the Bureau's staff of designers were generally centered around the use of refrigerating equipment, although the space required and the small bore of the tunnel were such as to render this approach of doubtful practicability.

The Government recognized that conditions in the tunnel were not similar to those contemplated when the construction contract was executed, thus establishing a basis for contract adjustment. In

December 1953 the contractor notified the Government that he desired to secure the completion of the tunnel by a subcontractor, the firms of Coker Construction Co. and Peter Kiewit Sons' Co. Negotiations were thereafter carried on with these organizations.

A change order under which the tunnel would be completed at a total increased cost of $4,176,350 over the original contract was issued, and work was resumed January 25, 1954, continuing steadily to the present time.

The subcontractor found it necessary to rehabilitate or replace long reaches of the pump discharge and ventilation pipes and power cable, and to replace a considerable amount of timber lagging supporting the roof of the tunnel. While these operations were in progress new pumps and compressors were secured and installed and the capacity of the electric power transformer station was increased. Advancing the heading was actually resumed in April 1954, and has continued to the present. As the work advanced the total water inflow to the tunnel increased to 7,800 gallons per minute or slightly more than 17 cubic feet per second. As the tunnel gradient is quite flat, all this water has to be pumped from the tunnel through two 12-inch and one 14-inch pipes. A total of about 20 pumps strategically located to handle the inflow have been installed, including one 10-inch (300 hp), two 8-inch (250 hp), two 6-inch (50 hp), all centrifugals. When one considers that there is also a 14-inch fan line and two 6-inch pipes for compressed air the restricted area for the use of mine cars and track can be envisioned. At passing tracks, which are provided at about one-mile intervals, the water pipes must be removed from their normal position on the sides of the tunnel and carried overhead, thus creating a "low bridge" to be crept under with circumspection. For ventilating purposes, at the portal a blower supplies 5,000 cubic feet of air per minute, which is carried to the heading through the 14-inch fan line, and the air is boosted on its way by a second blower some 12,000 feet in. Also near the portal there have been installed four compressors each having a capacity of 1,600 cubic feet of air per minute, to operate the drills and mucking machine and is also used to operate several "turbinair" pumps. And here is an interesting sidelight on the use of compressed air to operate equipment. The compressed air in performing work is exhausted from the equipment at a low temperature, often as low as 30° F. This cool exhaust air from the "turbinair" pumps is introduced into the ventilating pipe and thus materially reduces the temperature of the ventilating air delivered at the heading. This procedure results in maintaining tolerable working conditions at the heading, air temperatures generally ranging in the nineties with relatively low humidity. However, air returning through the open tunnel section rapidly becomes heated by contact with the rock walls and the inflowing water and attains a foggy almost 100 percent humidity. Air temperatures in the area where the car passing device is operated and where much of the pump maintenance and operation must be performed generally range around the 110° F. mark. Readers accustomed to summer temperature of 110° F. or higher may not be impressed by the temperatures in the tunnel but they are reminded that due to the high humidity there is no cooling effect of evaporation from the body surface and the body temperature tends to attain that of the surrounding atmosphere. Under this condition very little exertion results in complete exhaustion.

Due to the high temperature and humidity in most of the tunnel, transportation of workmen between the portal and the heading, and particularly through the 3,500 foot zone of high rock and water temperature presented a serious problem. The present procedure is to use ordinary man cars between the portal and short section of concrete lining about 11,000 feet inside the tunnel. At this point, there is a large inflow of relatively cool water (84° F.) and muck cars are filled with this water. The men immersed to the neck in these "bathtubs" are hauled to the heading, industriously splashing water on their face and head en route. Cars full of this cool water are left near the heading and at other working areas when hauling is not in progress and the workmen dunk themselves at frequent intervals to reduce the body heat.

Some of this so-called cool water is also piped to the heading and intervening working areas and sprays provided under which the men may stand when the bathtubs are not available.

By the adoption of these measures the heading is being steadily, if slowly advanced, progress generally being from 10 to 15 feet per day. At this writing about 3,900 feet remain to be excavated and while more inflowing water can well be expected, rock and water temperatures at the heading as it is advanced appear to be declining. It is believed that by continued use of the current methods and procedures the tunnel can be successfully completed. ###

Sacramento Canals

Continued from page 82

Canal, extending south for approximately 19 miles. A pumping plant would be constructed about 4 miles south of Vina to lift the water 30 feet.

Meanwhile the farmers have been holding meetings, discussing the pros and cons of forming irrigation districts. Now there are seven irrigation districts in various stages of formation. Two districts already have been formed: the Corning Water District in Tehama County, only 10 miles south of Red Bluff Diversion Dam, and the Arbuckle water district, in Colusa County, at the southern end of the service area.

So the issuance of specifications for the first 7½ miles of the Corning Canal will be the fulfillment of dreams and ambitions of many people over the last one hundred years or more. ###

CLARENCE A. DAVIS—NEW UNDER SECRETARY

Clarence A. Davis, a native of Beaver City, Nebr., Solicitor for the Department of the Interior, was sworn in as Under Secretary of the Department on September 1.

He succeeds Ralph A. Tudor, who resigned to return to private practice in San Francisco as a consulting engineer. Mr. Davis has been Solicitor for the Department since February 1953.

He is very well known throughout the West, has taken an extensive interest in Reclamation and is thoroughly familiar with the problems confronting it.

He has an extensive legal as well as administrative background which qualifies him thoroughly for this second ranking position in the Interior Secretariat. He attended Nebraska Wesleyan University, 1910–13, where he received his A. B. degree after completing four years work in three. In 1916, he graduated from the Harvard Law School (LL.B.).

Subsequent to graduation from Harvard, he practiced law in Omaha, Nebr., with the firm of Baldrige and DeBord. Mr. Davis was elected Attorney General in 1918, serving from 1919–23. He returned to general practice in Holdrege, Nebr., 1923–36; member of the law firm of Davis, Healey, Davies and Wilson; General Counsel to Western Public Service Co. 1925–41; General Counsel to Consumers Public Power District; Counsel to Missouri Valley Development Association; lecturer on administrative law, University of Nebraska, 1943; Trustee, Nebraska Wesleyan University, 1923–27.

He belongs to numerous legal organizations and societies and was President of the Nebraska State Bar Association in 1951.

Mr. Davis is married and has one son and three grandchildren. He and Mrs. Davis make their home at the Sheraton Park Hotel while in Washington, D. C. #

J. C. THRAILKILL Dies Unexpectedly

J. C. Thrailkill, Chief of Procurement and Property Management, died July 21. Although Mr. Thrailkill had been to work that day and appeared in relatively good health, he had a serious heart condition for some time. Mr. Thrailkill, born in 1892, first joined the Bureau in 1913 at the Boise project. He has held progressively responsible positions in supply and property management. A native of Wyoming, he was also a long-time resident of Yuma, Ariz. Mr. Thrailkill is survived by his wife and one son, John.

President's Trip

Continued from page 74

Irrigation Supervisor, Region 7, Bureau of Reclamation (Casper to Denver); C. Petrus Peterson, President, National Reclamation Association, Lincoln, Nebraska; and Dr. J. Porter Ahrens, President, Kansas Reclamation Association, Scandia, Kansas (McCook to Denver).

All along the route, the President kept up a running barrage of searching questions about Reclamation policies, plans, procedures; he wanted to know how the farmers and water users in the West felt about the Federal developments, both those completed and those planned for the near future. He also poured over the maps and other data supplied for his information.

On each leg of the journey, the individuals most familiar with the area then being viewed were at Mr. Eisenhower's side to answer questions, supply background information and discuss in great detail the many points raised by the President.

In the course of the tour, the President viewed Reclamation areas in the States visited as follows:

Colorado

Fryingpan-Arkansas project (proposed) in the Pueblo area for transfer of Colorado River Basin to the Arkansas River area to supplement irrigation supplies, provide municipal water and produce power; Grand Valley project, a producing area of 8,000 acres in the vicinity of Grand Junction, Colo.; Collbran project, near Grand Junction, authorized to supply supplemental water, irrigation and municipal, and produce power.

Utah and Colorado

Upper Colorado River Storage (proposed) endorsed for authorization specifically by the President. The plane, flying low, circled the site of the Echo Park Dam on the Yampa River in the Dinosaur National Monument which has been much in controversy.

Wyoming

Kendrick Project, near Casper, designed to irrigate 23,000 acres with Seminoe Dam, Alcova Diversion Dam, and power plant on the North Platte River; Kortes Dam and power plant, Missouri River Basin project; Pathfinder Dam, with storage reservoir to supply irrigation water for 200,000 acres in Wyoming and Nebraska included in the North Platte project, Glendo Dam site and the irrigated Platte Valley.

Nebraska

North Platte project irrigating 158,000 acres in Scotts Bluff area; Frenchman-Cambridge Unit of the Missouri River Basin project on the Republican River, east and west of McCook, including eventual irrigation of 53,000 acres, and Trenton, Medicine Creek (Harry Strunk Lake) and Enders, Harlan County, and Kingsley Dams for irrigation storage, flood control and recreation.

Kansas

Cedar Bluff Dam, constructed on Smoky Hill River; Bonny Dam, on South Fork Republican River; Kirwan Dam, under construction on the North Fork of the Solomon River; Webster Dam under construction on the South Fork of the Solomon River; (these three dams, units of the Missouri River Basin project, are multiple-purpose structures for irrigation storage, flood control and recreation).

The President was greeted at his field stops by crowds who welcomed him to the West and invited him to become better acquainted with their areas and their problems. ###

HOWARD ROBBINS DIES at MAYO CLINIC

We regret to announce, that as this issue went to press, we learned of the death of Regional Director Howard E. Robbins of our Amarillo, Tex. office.

Mr. Robbins, a reclamation engineer with 35 years' experience on water conservation projects in the western States, had been Regional Director at Amarillo since 1948.

He joined the Bureau in 1916 as a rodman and rapidly advanced in the engineering field until he became chief of survey party for the Bureau in 1929, and was subsequently placed in charge of construction work in connection with the water system at Klamath Falls, Oreg.

He worked both as an engineer and administrator on the Colorado Big-Thompson, W. C. Austin, (formerly Altus) and Valley Gravity projects before becoming assistant regional director of the Amarillo office in 1947.

A native of Denver, Colo., and a graduate of Colorado College, Colorado Springs, Colo., Mr. Robbins is survived by his widow and two daughters Mrs. Jack L. Hitt and Mrs. John Mulvihill.

MISSION ACCOMPLISHED

In cooperation with the President's Committee on NATIONAL EMPLOY the PHYSICALLY HANDICAPPED week, proclaimed by Hon. Dwight D. Eisenhower October 3–9 we present these typical examples of opportunities the Bureau of Reclamation is offering the handicapped persons.

RUSSELL M. HURD—*Photo by N. T. Novitt*

When "RUSS" HURD stepped forward this year to receive a handsome trophy for compiling the high individual scoring average for his team in the Denver Reclamation Bowling League, nobody paid much attention to the fact that Russ had won, despite the fact he has only one arm.

Nobody paid much attention mainly because Russ himself doesn't pay much attention to the absence of his left arm. As a matter of fact, he never has allowed his "handicap" to be a handicap.

Russell M. Hurd was ready for his senior year at Montana State College back in the summer of 1931 when his left arm was nearly torn off by a gravel crushing machine on which he was working. It took his fellow workers more than a half-hour to extricate Russ after his arm became entangled in the machinery when an excited workman started up the equipment Russ was repairing. During that half-hour, Hurd was fully conscious, and, more than that, he knew that his arm was mangled beyond saving. He decided right then that loss of the limb was not going to blight and limit his whole life—that it wasn't going to make a bit of difference to him or to anyone else.

How well Russ struck to that determination is reflected by his life since that day of the accident. He went back to school a few weeks later and received his degree in Dairy Industry the following spring. Then he entered Iowa State College and obtained a M.S. degree in agricultural economics in 1934.

Hurd's career in government service began in 1934 with the Soil Erosion Service, Department of the Interior. In 1945, he joined the Bureau of Reclamation staff at Phoenix, Ariz. In 1947, Hurd was transferred to the Bureau's Region 7 office in Denver and less than two years later he was promoted to his present position in charge of programing in the Operation and Maintenance Division.

In his present post, Russ is a wheel-horse, and his judgment, experience and abilities are known and respected among his colleagues.

In golf, Hurd has been a heart-breaker to many a frustrated duffer. He has fired his way around top-flight courses in the low 80's putting to shame many of his two-armed opponents with his deadly control and putting.

Fishing, too, has been one of Hurd's many sports hobbies. Ever try to tie a dry-fly while standing out in the middle of a rushing trout stream? Russ does it with the same one-handed dexterity he exhibits while shuffling and dealing cards in a friendly game with the boys.

One of the secrets behind Hurd's ability to shrug off so completely the loss of an arm—aside from the mental attitude he formed even before his buddies freed him from that rock-crusher—is that Russ was always a good athlete and had developed good coordination and dexterity before the accident. He played basketball in the days of the famous Golden Bobcats at MSC, and also lettered in track and football. Loss of his arm ended Hurd's collegiate athletic career, but he kept his hand in by officiating in basketball. He was also honored in his senior year at Montana State by being picked to coach the Rosary High School basketball team.

Russ isn't the least sensitive about his empty sleeve. He operates strictly on a theory he has proven since he lost his arm: "How you act yourself is the key. If you pay no attention to the arm's being gone, you find people reacting—they soon stop paying attention, too."

FLORENCE M. GESSING is presently employed by the Bureau of Reclamation, Parker-Davis Project, Transmission Division, Phoenix, Ariz. She began working for the Bureau of Reclamation on June 7, 1954, as a clerk-stenographer. At the age of 18 months, she was stricken with polio. Florence is engaged to an accountant who is also handicapped and who is employed in private industry. She has been employed by the Federal Government for almost seven years, having worked for the Veterans' Administration and the Farmers Home Administration before coming to the Bureau of Reclamation.

Her disability has never interfered with her work. She is most cheerful and very efficient in the performance of her work assignments.

RAY THURMAN PIERCY, 27, former Adrain High School athlete and Navy veteran is performing the important job of keeping the books and records in the efficient office of the North Board of Control, Nyssa, Oreg. He suffered a severe attack of polio in 1947 which makes it necessary for him to attend to his duties from a wheel chair.

In the course of his work, he helps many of the water users who come into the office to obtain information, or make requests concerning the 65,000 irrigated acreas of fertile land whose records are kept at Nyssa. From his desk he operates the central station of the radio phone communication system which provides ready contact between the office and the watermasters and ditchriders on the canals.

Mr. Piercy, a native of Filer, Idaho, graduated from Adrian High School where he was a letterman in football, basketball, track and baseball. His tour of duty in the Navy followed and he was stationed aboard warships operating in the Pacific.

Three years after the polio attack he was married to the former Margaret Garwood. They have two children, Anita, 2 years old, and Janice, 1. He is a member of the American Legion and Veterans of Foreign Wars. Mr. Piercy is active in the sports of hunting and fishing, and by the time this issue of the Era appears will have again participated in the annual Southeastern Oregon antelope hunt. (*Editor's Note: Information and photos by Henry L. Lumpee, Central Snake Projects Office, Region I*).

SAMUEL J. HEILIGERS is presently employed by the Bureau of Reclamation on the Parker-Davis project, Davis Dam Division. Sam, at the age of 18 months, was stricken with spinal meningitis. The dreadful disease left him with curvature of the spine and underweight. Sam has proven that such physical handicap does not keep him from performing his duties as general clerk (finance) in a most satisfactory manner. He began his career with the Federal Government in 1942 with the U. S. Engineering

Top photo l. to r.—Raymond Ahern, Benjamin Rutherford, and Samuel J. Heiligers. Above—Earl Jobe. At right—Herbert A. Rieckmann.

Department as a safety inspector at the Kingman Army Air Field, Kingman, Ariz., where he served until 1946. He then transferred to the accounting section of the Bureau of Reclamation at Davis Dam during this same year and has served in this branch ever since.

His supervisors consider Mr. Heiligers a capable, dependable, steady and cooperative worker.

One of Sam's fellow employees is RAY AHERN who was born in Tulsa, Okla. Ray began his career with the Bureau of Reclamation at Davis Dam in 1947 and has served continuously as a clerk in both the supply and finance sections on the project. For the past 20 years Ray has had arthritis of the spine which has restricted movements of his body. The fact that Ray does not have freedom of movement of his body hinders him not at all in performing his assigned duties.

Like Sam, Ray is doing very well in his position and is rated by his supervisors as being a steady, dependable and cooperative worker.

In addition to Sam and Ray, there is another physically handicapped employee at Davis Dam named BENJAMIN RUTHERFORD. Known as "Benny" to his fellow employees, he started to work for the Bureau of Reclamation at Davis Dam in 1947 and has been working continuously in the custodial service of the project ever since. As a young fellow at the age of 12, while playing, he fell from a bridge. The fall left Benny with a curvature of the spine; the result handicapped him to the extent that he was unable to perform hard physical labor. Benny, in the face of his physical handicap, accepts his misfortune in a cheerful way. You can learn from his supervisors that Benny performs all duties assigned him in the Davis powerplant in a dependable and satisfactory manner.

HERBERT A. RIECKMANN, 34, who is employed as an Engineering Draftsman by the Missouri-Souris Projects Office in Bismarck, N. Dak., was stricken with infantile paralysis at the age of 4, which paralyzed both of his arms and his legs. He had the use of neither for approximately 2 years. He eventually regained the use of his arms and with the aid of crutches was able to get around to some extent. His right leg, however, was badly crippled as a result of the paralysis and given the choice of wearing a heavy brace on it which would have been cumbersome and made it exceedingly difficult for him to get around, or having the leg removed, he decided to have the leg amputated and to be fitted with an artificial limb. This surgery was performed in 1935.

However, this did not discourage his efforts to obtain an education and earn his livelihood. Herb attended the State School of Science in Wahpeton, N. Dak., graduating in 1947 from a 2-year course in architectural drafting. He joined the Bureau of Reclamation at Wolf Point, Mont., as a draftsman in August 1949, remaining there until his transfer to Bismarck in March 1951. Despite his handicap, he has become a skilled draftsman and a valuable employee of the engineering services section. He does a variety of technical drawing which includes drafting in the fields of civil engineering, architecture, structural design, cartography, topography, geology, etc.

He is married and has two daughters, Donna Mae and Deborah Ann.

EARL JOBE, of the Salt River Valley Water Users Association, in Phoenix, Ariz., performs a variety of jobs such as waiting on the public, answering telephones, dispatching radio messages, etc., despite the loss of his left arm.

He is considered an outstanding workman by his supervisor and co-workers. In addition to his full-time job with the Association, he manages to keep his 40-acre farm at Laveen running smoothly with a portion of it leased out to cotton growers, and doing the rest of the work himself.

Mr. Jobe is a bachelor, and one of his main hobbies is raising registered purebred Duroc hogs.

These are just a few examples of physically handicapped people who are doing a worthwhile job. On the Columbia Basin project alone, at least 100 employees are physically handicapped in one way or another and to varying degrees.

In closing we should like to repeat a quote from President Eisenhower's Proclamation: "I request the Governors of States, the mayors of municipalities, other public officials, leaders of industry and labor, and members of religious, civic, veterans', agricultural, women's handicapped persons', and fraternal organizations, to participate actively in this observance." The President pointed out that this marks the tenth year that the "Week" authorized by a joint resolution of the Congress, approved August 11, 1945, has been observed. FURTHERMORE, WHILE ONLY A WEEK IS OFFICIALLY OBSERVED EACH YEAR, HE EMPHASIZED THE NEED FOR A YEAR-ROUND PROGRAM.

FLORENCE M. GESSING with her fiance

WATER REPORT

By CLYDE E. HOUSTON, Senior Civil Engineer and HOMER J. STOCKWELL, Hydraulic Engineer, Soil Conservation Service[1], United States Department of Agriculture

Water in the west during the irrigation season of 1954 was a subject of extreme variations from what we consider to be normal. At the end of the snow accumulation season in April the water supply outlook indicated that stream-flow would be adequate or possibly excessive in the Pacific Northwest. On the other end of the scale water supplies were expected to be extremely short in the southern Rocky Mountain region and in some parts of Utah and Nevada. This early season outlook was followed by an extreme deficiency in precipitation during April, May, and June. Many weather stations in Colorado, New Mexico, and Utah recorded new highs in temperature and new lows in precipitation for an extended period. The final result was that actual stream-flow was less, in some areas much less, than that indicated by stream-flow forecasts issued for the west in April 1954. In the northwest, although stream-flow was above normal, no material flood damage resulted. Water supplies were adequate and reservoir storage increased. In Colorado, Utah, and New Mexico the water shortage was more severe than anticipated. Crop production was curtailed. Reserve supplies of water stored in reservoirs of the Bureau of Reclamation, the irrigation companies, the municipalities were seriously depleted. Pumping from underground sources was extensively used. These two sources of water alleviated shortages that might otherwise have been disastrous.

Since carryover reservoir storage is a substantial factor in 1955 water supplies, this must be especially noted when considering the outlook for next year. In the states of Nevada, Utah, Wyoming, Colorado, New Mexico and in local areas of other states carryover storage is much less than normal. An above normal snow pack next year along with favorable precipitation in valley areas will be

[1] The Soil Conservation Service is the federal coordinating agency for snow surveys conducted by its personnel and many cooperators including the Bureau of Reclamation, other federal agencies, water departments of several states, irrigation districts and private organizations in all mountain states except California. The California State Division of Water Resources conducts snow surveys in that state and has contributed information on California appearing in this article.

RALSTON CHUTE, Shoshone project, Wyo. *Photo by Chas. A. Knell.*

necessary to provide adequate water supplies. In the Pacific Northwest and Montana the carryover storage is excellent. Storage in Arizona reservoirs is above average due to heavy rains in late summer. Groundwater levels continue to decline. Lake Mead is at the lowest level since filling was started in 1935.

In the following paragraphs 1954 water supply conditions is summarized for each state. A chart showing reservoir storage as of September 1 compared to the 1942–51 average for this date indicates carry-over storage for each state.

ARIZONA.—Reservoir storage in Arizona at the present time is relatively good, compared with recent years. The Salt-Verde system holds adequate water for a good carry-over that would meet next year's need for irrigation water with only nominal spring flows. San Carlos reservoir, while below the 10-year average figure, is higher than in recent years and contains adequate water to meet demands for the balance of this season. The same is true of Lake Pleasant on the Agua Fria River. Smaller reservoirs, in the White Mountain area are at low levels as is usual at this season, though recent storms have provided some increases in storage.

The water supply situation has been generally rather tight throughout the state this season, with the exception of the Salt River Valley. Summer rains have produced some good flows locally, but have been quite scattered especially in the southerly portion of the state where some

areas are very dry and others have had local flooding and record-breaking storms. The San Carlos Project has experienced another year of very tight water supplies only recently relieved somewhat by capture of flood flows in the reservoir. Ground water levels have continued to decline as in the past and new record lows are being encountered.

CALIFORNIA.—The April 1 runoff forecasts of the California Division of Water Resources indicated that snowpack water supply for the Central Valley would be approximately 87 percent of normal during the 1954 season. April precipitation was near normal, and total May 1 expectancy remained about the same although individual stream forecasts were adjusted in accordance with local precipitation patterns. Precipitation during May was well below normal and as a result, at the end of the month forecasts on most streams were reduced small amounts. Based upon preliminary records, subject to revisions, the total snowmelt runoff proved to be 85 percent of normal. The forecasts of April and May were therefore high by approximately 2 percent and the forecast of June 1 proved to be in error by less than half one one percent.

COLORADO.—The year 1954 was noted for an extreme water shortage over most of Colorado. The only areas not affected to some extent were those where most of the irrigation water comes from underground sources. Expansion of the use of pumps and sprinkler irrigation was continued.

Fortunately, this shortage of stream flow was anticipated due to the low snowpack of the 1953–54 season. Crop acreage was reduced, particularly the acreage in high water using crops. Near record lack of precipitation over most of the state during the late spring and early summer months further reduced the water supplies. The only areas of the state where water supply was reasonably adequate was on the Pine, Animas and Dolores Rivers in Southwestern Colorado and on the main stem of the Colorado River near Grand Junction. This was partially due to above normal summer precipitation locally and the fact that there is excess water in normal years.

In San Luis Valley, crop production was near normal with extensive use of pumps. Stream flow was about 60 percent of normal on the Upper Rio Grande, and Conejos and Alamosa Rivers. Precipitation during July and August was above average.

East of the Continental Divide the drouth extended throughout the growing season. Along the Arkansas River and its tributaries crop production was substantially reduced with some land left idle. Seasonal stream flow of the Arkansas River was about 60 percent of normal.

Reduction in acreage of sugar beets and alfalfa was also noted on the South Platte irrigated area. Natural stream flow on the South Platte and its tributaries was the lowest of record. Water supply was particularly short on the Upper South Platte, Clear Creek and Boulder Creeks. On the Northern tributaries including the lower South Platte, the Colorado-Big Thompson Project supplied approximately 45 percent of total water supply in 1954 as compared to its design to supply about 20 percent. The project still has in storage about 350,000 acre-feet. Deliveries for 1955 could approximate those of 1954 if the demand is present. Should the snow pack during the 1954–55 winter season be substantially less than normal the backlog of stored water will be very short after the 1955 season.

Irrigation water storage east of the Continental Divide is negligible in privately owned reservoirs. Most of the stored water is in the Colorado-Big Thompson Project and in Denver Municipal water supply. Denver has only 50 percent of the 10 year average water supply in storage as of September 1, 1954.

A well above normal snow pack and well distributed spring and summer precipitation will be needed to assure adequate water supplies in 1955. The hold-over outlook is extremely poor in Colorado.

IDAHO.—The State of Idaho experienced unusually higher water and heavy volume flows throughout the Northern portion of the state. The main tributary of the Snake River ran slightly above normal, but all southern tributaries, that is rivers flowing north into the Snake River experienced a very poor water year. Preliminary figures issued by the Geological Survey up through the month of August and estimated flows for the month of September indicate that the Kootenai River in Northern Idaho will probably break all records for high flows to date, 12,313,000 acre-feet April through September. This extremely high flow was forecast on the first of April as a result of the heaviest snow pack ever experienced on that river.

The Kootenai River also flowed more water in the months of July and August than has ever been experienced in 44 years. The wide divergence in snow cover experienced in northern Idaho as against southern Idaho areas resulted in a similar pattern of streamflow which was excessive water in the north and insufficient water along the southern edge of the state.

KANSAS.—Water supply along the Arkansas River in Southwestern Kansas was much less than average during the 1954 irrigation season. Above normal rainfall during the late summer months improved crop production over the early spring outlook.

MONTANA.—The irrigation season over this State in general has been exceptionally good. No drought situations have developed. Mountain stream-flow was normal or above for most streams. The plains area of the state has received a number of thunderstorms that maintained good soil moisture conditions and stock ponds have remained sufficiently full for good use. The Kootenai and Flathead rivers have had close to record high flows during the runoff season.

Reservoir-stored water is excellent in all reservoirs throughout the State. Local shortages have been caused by summer repairs to head works at Lima, Dry Fork and Ruby reservoirs. No acute shortages have occurred.

NEBRASKA.—Storage on the Platte system is below normal for this time of year, and there is no more water to be expected from the North Platte; however, precipitation has reduced delivery requirements considerably.

Range lands in Nebraska are in poor shape as the result of the low fall precipitation factor and below normal spring and summer precipitation.

NEW MEXICO.—Drouth and its related shortage of irrigation water is becoming commonplace in New Mexico. The season of 1954 was a continuance of a series of drouth

years. Water supply along the Rio Grande was about 25 percent of normal. Crop production in the middle Rio Grande Valley was very limited. Extensive development of pump irrigation in the Mesilla Valley below Elephant Butte reservoir has eliminated complete dependence on stream flow and stored water. There was some reduction in alfalfa acreage on the lower Rio Grande in New Mexico but cotton production was maintained. Crop conditions are fair to good. A similar shortage of water occurred on the Carlsbad Project in Southeastern New Mexico and on the Arch Hurley Conservancy District at Tucumcari.

Total storage in irrigation reservoirs in New Mexico is extremely low, less than 10 percent of normal. A much above average snow pack and favorable precipitation in irrigated areas will be necessary to provide adequate water supplies in 1955. A series of good water years will be required to change the water supply outlook in New Mexico.

NEVADA.—On September 1, 1954, water in storage in Nevada ranged from good at Lake Tahoe in the western portion to poor at Rye Patch on the lower Humboldt River in Northern Nevada. Lake Mead, above Hoover Dam, is at the lowest level since it was allowed to fill in 1935. Boat docks and recreational areas have been moved down to the lowered water line. Rye Patch, as of September 1, stored only 1,110 acre feet, or 0.6 percent of capacity. Bridgeport Reservoir and Topaz Lake on the Walker River are expected to drain all of their effective storage by the end of the current irrigation season. Lands on the Newlands Project using water from the Lahontan Reservoir on the Carson River expect to have enough carryover storage to give them water for the 1955 irrigation season, provided normal snow occurs on their Sierra watershed this winter.

During the 1954 irrigation season the water users in Northern Nevada along the Humboldt have been short. At the Palisade gaging station the flow of the Humboldt was only 12 percent of the past ten year (1942–51) average. The ranchers in this section have called a meeting to consider using weather modification to produce more precipitation. Hay production is below normal and summer ranges were depleted at an early date. Stock has been moved to winter ranges for grazing and early feeding will be required. Some ranchers have moved their stock to other sections or have sold off part of their herds.

Unless Nevada has a good snowpack this coming winter, next summer will be the third year of drought in this state. Water users who depend on reservoir water will also be short. Reservoirs, in general, are going into the winter exceptionally low.

OKLAHOMA.—Streamflow into Lake Altus was about 80 percent of normal for 1954. Precipitation during the summer season was well below average but crop conditions are good on the W. C. Austin project. Carryover storage as of September 1 is about 60 percent of average for this date.

OREGON.—Oregon's 1954 water season has varied from the extreme of "excellent" to "poor" in much the pattern as forecast on April 1, 1954.

Above normal water supplies have been available in the Klamath, Goose Lake, Rogue, Umpqua, and Deschutes basins, while the Walla Walla, Umatilla, Grande Ronde, Powder, and Burnt River drainages have been short of water where dependent upon natural flow.

Natural streamflow in the Malheur and Owyhee basins has been far below normal as forecast but the year brought sufficient water to most users because of excellent storage facilities.

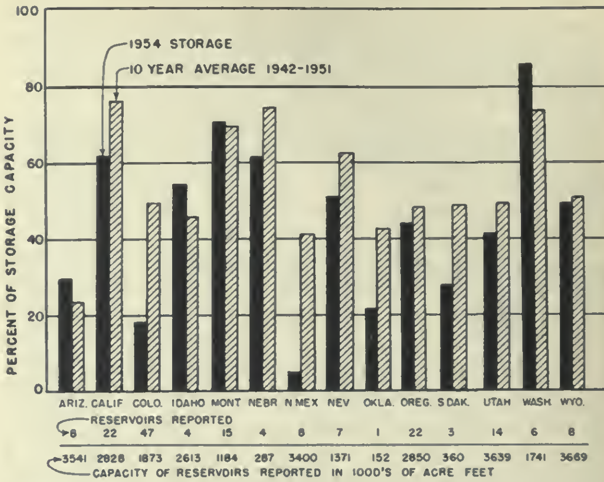
Reservoir storage as of September 1 is 91 percent of average in 22 Oregon reservoirs and 43 percent of capacity. However, the present storage in Owyhee and Malheur reservoirs is record low and will require a bountiful winter to refill sufficiently for a good water year.

Present storage in Owyhee is 190,000 acre-feet or 44 percent of the 1942–51 average. Not since 1934 has storage been this low at this season. Agency Valley and Warmsprings reservoirs on the Malheur are 54 and 65 percent of the 10 year average respectively.

SOUTH DAKOTA.—Reservoir storage for South Dakota is adequate for the remainder of the season. The carryover storage for next year is considerably below normal.

TEXAS.—Water supply conditions on the irrigated district near El Paso is similar to the adjacent area in southern New Mexico. Diversions from the Rio Grande were about 25 percent of average. Crop production was maintained through supplemental water supply from about 1,400 irrigation wells. Crops in irrigated lands in

RESERVOIR STORAGE
SHOWN IN PERCENT OF CAPACITY



Average storage for some reservoirs for a shorter period than 1942–51. ARIZONA—Does not include Lake Havusu or Lake Mohave. September 1 total storage 2,150,000 acre-feet or 86 percent of capacity. CALIFORNIA—Does not include Millerton, Shasta, Pine Flat, or Isabella Reservoirs. September 1 storage in these four reservoirs combined was 3,576,340 acre-feet or 54 percent of capacity. COLORADO—Does not include John Martin Reservoir. September 1 storage 13,000 acre-feet or 2 percent of capacity. Does not include Granby, Horsetooth, or Carter Lake Reservoirs, September 1 storage 350,000 acre-feet or 49 percent of capacity. MONTANA—Does not include Fort Peck, September 1 storage 12,130,000 acre-feet or 64 percent of capacity. Does not include Flathead Lake, September 1 storage 1,796,000 acre-feet or 90 percent of capacity. NEBRASKA—Does not include Sutherland Reservoir, September 1 storage 1,127,000 acre-feet or 60 percent of capacity. NEVADA—Does not include Lake Mead, September 1 storage 14,250,000 acre-feet or 52 percent of capacity. WASHINGTON—Does not include Franklin D. Roosevelt Lake. September 1 storage 9,554,000 acre-feet or 101 percent of capacity. WYOMING—Does not include Boysen Reservoir, September 1 storage 521,000 acre-feet or 69 percent of capacity.

Texas are reported as excellent where the major water supply is from pumps.

UTAH.—This year Utah has experienced the poorest runoff it has had in the last 15 or 20 years. Areas in the State which are largely dependent on natural streamflow without reservoir storage water rights have suffered the most. Spring and summer rains, which are generally counted on to give crops an added boost, were very light and ineffectual except in a few scattered areas. It is estimated that crops on lands with natural flow water rights in northern Utah will produce about 75 percent of average, the shortage coming not because of decreased acreages, but because of decreased yields. In central and southeastern Utah, crop production is about 50 to 80 percent of average, with a few small areas reported as low as 20 percent.

Water users with reservoir storage rights have generally had sufficient water to mature their crops. This has caused very heavy depletion of reservoirs. As of September 1, there was 41.7 percent of capacity in 14 of the larger reservoirs. In comparison, the average storage in these reservoirs for the 10 years 1942–51 was 49.2 percent of capacity. As of April 1 this year these reservoirs held 66 percent of capacity. The April 1 10-year average was 54 percent. This means that the average 10-year reservoir depletion from April 1 to September 1 was 4.8 percent. This year reservoir depletion has been 24.3 percent, or five times the average amount.

In the Sevier Valley of southern Utah, crops have generally been excellent this year. However, by the last week of August, the Otter Creek and Piute reservoirs were virtually empty with the result that a 56 percent cut from spring water allotments has been made. An estimated 3,000 acres of sugar beets and 500 acres of potatoes will be affected, producing lowered yields.

WASHINGTON.—Reservoir storage as of September 1, 1954 is 13 percent above the 1942–51 average. The use of irrigation water during the summer months in Washington has been considerably below normal due to the above average rainfall throughout most of the state.

The heavy snows of the past winter were tempered by a cold late spring and the expected high peak discharges were in most cases not experienced. Above average volumes were recorded on the rivers in northern Washington, but because of this late spring, no extensive flood damage occurred. During the months of April, May and June approximately 9,700,000 acre-feet of water was stored in Columbia Basin reservoirs. These reservoirs were all lowered prior to the snowmelt period in order to reduce as much flood damage as possible.

WYOMING.—The reservoirs on the Snake River and Bighorn River drainages contain adequate storage for the balance of 1954 irrigation requirements. Carryover storage is somewhat less than desirable for the 1955 season on the Riverton project. Irrigation water for 1954 was generally satisfactory.

On the North Platte River, the water supply for the North Platte project has been restricted in 1954. Only a few thousand acre-feet remain for distribution this year. Then stored water will be exhausted. Ample water is available for the Kendrick project to assure irrigation requirements for a number of years. A well above normal snow pack will be required to assure an adequate water supply on the North Platte for 1955.

Spring and summer precipitation throughout Wyoming has been considerably below normal with the resultant reduction in runoff and range growth. The present range condition is a partial result of the deficiency in soil moisture last fall. It is expected that range conditions will be below normal next year because of dry soils at this level.

Water Stored in Western Reservoirs

(Operated by Bureau of Reclamation or Water Users except as noted)

Location	Project	Reservoir	Storage (in acre-feet)		
			Active Capacity	Aug. 31, 1953	Aug. 31, 1954
Region 1	Baker	Thief Valley	17,400	(1)	5,000
	Bitter Root	Lake Como	34,800	16,000	13,500
	Boise	Anderson Ranch	423,200	367,400	365,500
		Arrowrock	286,600	132,000	101,000
		Cascade	654,100	238,400	228,900
		Deadwood	161,900	127,000	107,600
		Lake Lowell	169,000	50,100	48,800
	Burnt River	Unity	25,200	10,600	8,000
	Columbia Basin	F. D. Roosevelt	5,220,000	5,072,000	5,072,000
		Equalizing	761,800	428,000	760,800
		Potholes	513,000	81,500	46,000
	Deschutes	Crane Prairie	55,300	39,000	79,000
		Wickiup	187,300	90,000	46,000
	Hungry Horse	Hungry Horse	2,982,000	2,781,900	2,972,200
	Minidoka	American Falls	1,700,000	769,300	884,900
		Grassy Lake	15,200	11,600	11,700
		Island Park	127,200	64,700	76,500
		Jackson Lake	847,000	431,900	506,300
		Lake Walcott	80,000	93,900	93,600
	Ochoco	Ochoco	47,500	(1)	25,000
	Okanogan	Conconully	13,000	8,100	(1)
		Salmon Lake	10,500	10,300	(1)
	Owyhee	Owyhee	715,000	466,700	188,000

See footnote at end of table.

Water Stored in Western Reservoirs—Continued

Location	Project	Reservoir	Storage (in acre-feet)		
			Active Capacity	Aug. 31, 1953	Aug. 31, 1954
Region 1	Umatilla	Cold Springs	50,000	14,100	10,100
		McKay	73,800	28,400	13,800
	Vale	Agency Valley	60,000	29,500	14,600
		Warm Springs	191,000	113,900	35,400
	Yakima	Bumping Lake	33,700	16,600	22,700
		Cle Elum	436,900	386,300	343,400
		Kachess	239,000	177,800	180,100
		Keechelus	157,800	102,900	115,900
		Tieton	198,000	141,800	159,100
Region 2	Central Valley	Keswick	23,800	19,300	19,300
		Millerton Lake	500,000	235,900	163,700
		Shasta	4,374,100	3,606,500	3,167,800
	Klamath	Clear Lake	513,300	256,500	241,700
		Gerber	94,300	57,100	36,200
		Upper Klamath Lake	524,800	319,400	278,200
	Orland	East Park	47,900	25,300	13,300
		Stony Gorge	50,000	27,500	18,600
Region 3	Boulder Canyon	Lake Mead	27,207,000	19,072,000	14,294,000
	Davis Dam	Lake Mohave	1,809,800	1,185,900	1,522,200
	Parker Dam Power	Havasu Lake	688,000	623,100	632,300
	Salt River	Bartlett	179,500	14,000	30,000
		Horse Mesa	245,100	241,000	213,000
		Horseshoe	142,800	9,000	1,000
		Mormon Flat	57,900	43,000	55,000
		Roosevelt	1,381,600	765,000	589,000
		Stewart Mountain	69,800	38,000	59,000
Region 4	Eden	Big Sandy	35,000	[1]	9,300
	Fruitgrowers	Fruitgrowers	4,500	[1]	300
	Humboldt	Rye Patch	179,000	97,900	1,100
	Hyrum	Hyrum	15,300	5,400	2,600
	Mancos	Jackson Gulch	9,800	5,400	2,500
	Moon Lake	Midview	5,800	5,400	1,700
		Moon Lake	35,800	7,700	600
	Newlands	Lahontan	290,900	203,500	123,200
		Lake Tahoe	732,000	663,600	547,200
	Newton	Newton	5,300	1,500	200
	Ogden River	Pineview	44,200	17,300	9,600
	Pine River	Vallecito	126,300	53,500	60,700
	Provo River	Deer Creek	149,700	114,700	74,600
	Scofield	Scofield	65,800	40,000	10,000
	Strawberry Valley	Strawberry Valley	270,000	221,700	168,500
	Truckee Storage	Boca	40,900	25,800	12,500
	Uncompahgre	Taylor Park	106,200	89,200	56,700
	Weber River	Echo	73,900	32,000	8,300
Region 5	W. C. Austin	Altus	166,300	17,200	35,100
	Balmorhea	Lower Parks	6,500	200	5,300
	Carlsbad	Alamogordo	131,900	12,800	13,500
		Avalon	6,000	2,400	4,600
		McMillan	38,700	500	6,400
	Colorado River	Marshall Ford	1,835,300	605,400	589,100
	Rio Grande	Caballo	340,900	28,200	16,600
		Elephant Butte	2,185,400	110,500	32,900
	San Luis Valley	Platoro	60,000	0	100
	Tucumcari	Conchas [2]	465,100	64,500	[3]−4,200
Region 6	Missouri River Basin	Angostura	92,000	39,400	35,100
		Boysen	710,000	641,100	521,100
		Canyon Ferry	1,615,000	764,700	971,500
		Dickinson	13,500	5,800	3,500
		Heart Butte	218,700	70,400	59,900
		Keyhole	270,000	11,300	7,000
		Shadehill	300,000	82,500	79,500
	Belle Fourche	Belle Fourche	185,200	106,200	60,100
	Fort Peck	Fort Peck [2]	14,877,000	10,647,700	7,559,300
	Milk River	Fresno	127,200	72,200	95,600
		Nelson	68,800	41,800	50,600
		Sherburne Lakes	66,100	34,300	44,600
	Rapid Valley	Deerfield	15,100	14,300	9,800
	Riverton	Bull Lake	155,000	141,300	115,500
		Pilot Butte	31,600	11,000	10,600
	Shoshone	Buffalo Bill	380,300	360,900	293,300
	Sun River	Gibson	105,000	56,900	56,800
		Pishkun	30,100	19,200	26,100
		Willow Creek	32,400	24,900	23,300
Region 7	Colorado-Big Thompson	Carter Lake	109,100	[1]	10,900
		Granby	465,600	426,400	243,600
		Green Mountain	146,900	131,700	64,600
		Horsetooth	141,800	53,400	6,700
		Shadow Mountain	1,800	1,500	1,000
	Missouri River Basin	Bonny	39,900	35,100	37,000
		Cedar Bluff	176,800	65,200	51,600
		Enders	30,000	20,200	27,900
		Harry Strunk Lake	33,900	23,400	18,400
		Swanson Lake	116,100	[1]	23,500
	Kendrick	Alcova	30,300	16,300	14,200
		Seminoe	993,200	605,200	300,500
	Mirage Flats	Box Butte	30,400	10,700	8,700
	North Platte	Guernsey	44,200	10,200	21,700
		Lake Alice	11,400	6,000	2,400
		Lake Minatare	57,800	24,300	6,400
		Pathfinder	1,010,900	467,600	344,600

[1] Not reported.
[2] Corps of Engineers Reservoir.
[3] Minus active storage figure due to pumping from dead storage during the month.

LETTERS

Help to N. D. R. A.

DEAR SIRS: The interesting article in the August issue of "The Reclamation Era" entitled "Is Irrigation in Central North Dakota Worthwhile?" looks like the answer to one of the association's publicity and education problems.

For some time I have been thinking of a folder to serve as a mailing piece and for distribution at farmer meetings on the Deep River farm. Reprints of the three pages with a blank back page for our own NDRA message look just like what the doctor ordered.

Would you find out whether we could have permission to have the reprints made?

The author (or authors) are to be congratulated on both the Deep River article and the second one on Recreation at the Heart Butte Reservoir.

Sincerely,

R. L. DUSHINSKE.

"DON'T FORGET THE DROUTH"
North Dakota Reclamation Association
Affiliated with the National Reclamation Association
OFFICE OF EX-OFFICIO DIRECTOR

Reprint permission was gladly granted. —Ed.

Likes The *Era*

DEAR SIRS: We just received our first issue of "The Reclamation Era" and are delighted with it. We are wondering if you have published any articles on "Tuttle Creek Dam" in Kansas. Thanking you very much for any information that you can give us.

Very sincerely yours,

/s/ E. E. WALTERS
Box 96 A
Sunnymead, Calif.

Tuttle Creek Dam is a Corps of Engineers project and we have referred your inquiry to that Agency for reply.—Ed.

Interested in "Chemicals"

DEAR SIR: Thank you for the additional copies of the May 1954 RECLAMATION ERA which you forwarded for my files. We received the photographic material which we supplied in conjunction with the article Chemicals Cure Seed Crops.

The method of handling the information was very well done and the layout and use of illustrations fitted the story very well. It has been a pleasure to work with you.

Very truly yours,

VAL E. WEYL, *Editor*
NACA News and Pesticide Review.

Subsequent to receipt of Mr. Weyl's letter, we had a telephone call from him stating that the Editor of the Montana Farmer-Stockman desired to reprint Chemicals Cure Seed Crops in his publication.

Permission to do so was gladly granted.—Ed. #

RELEASES

New Maps Available

The Drafting Section of the Bureau of Reclamation has recently completed the following project maps: Mirage Flats project, Nebraska; Newton project, Utah; and Scofield project, Utah. These maps are available in both the small (10½ by 17 inches) and large (21 by 34 inches) sizes. These maps are all in color, and requests should be sent to your nearest Regional director (see directory on the back cover of this issue), specifying the names and size of maps desired.

Single copies are free to those who have need of them in connection with their work or studies.

CROPS

1953 Record Year

Water users on 69 western Reclamation projects, during 1953, realized a record harvest of 25.7 million tons of crops. This represents an increase of 2.1 million tons above the 1952 crop.

The gross value of all crops totaled $785.9 million. Despite some rather sharp declines in crop values which were in keeping with the National agriculture picture, this was the third highest value in Reclamation history, and it marked the eighth consecutive year in which the value of Reclamation produced crops exceeded one-half billion dollars.

Per acre yields for most crops were equal to or higher in 1953 than in 1952. Volume production increased for all major crops except seeds. Twenty-one percent or 5.5 million tons of the total harvest were food products consisting of fruits, nuts, vegetables, truck crops, and beans, many of which are classed as protective foods and are considered necessary for proper physical growth and maintenance of a strong and healthy population.

Again in 1953, the stabilizing influence of Reclamation on western agricultural economy was evidenced in the production of nearly 13.5 million tons of feed and forage crops. This represents a significant contribution to the proper utilization of the 700 million acre western range, much of which is usable only in connection with "feed base" land. During 1953 this sizable tonnage of feed and forage crops being shipped from Reclamation project areas to the Plains States to help mitigate the disastrous effects of the drought there took on definite added significance.

DO YOU KNOW . . . .

- Hoover Dam was the first Bureau of Reclamation dam of which operating models of the various features were built in order to check the adequacy of the hydraulic structure?
- More than 100 million acres of fertile land in America—or about one-fifth of the Nation's land now available for crops—have been made arable or more productive by drainage improvements, says a Twentieth Century Fund report?
- Enough dates are produced annually in the Coachella Valley of California and on other irrigation projects in the southwest to feed 65 million people?
- Enough lettuce is produced annually on Reclamation projects in the southwest to feed over 36 million people?
- Enough carrots are produced annually on Reclamation projects in the southwest to feed over 20 million people?
- Tule Lake, located on the Klamath Project in Northern California and Southwest Oregon, had a water surface area of approximately 96,000 acres in 1910 but today is confined to an area of about 13,200 acres, with another 18,600 acres of agricultural land reserved to pond extreme floods?
- Tule Lake is a sump which has no natural outlet, although the elevation of the sump is about 50 feet lower than the water surface of Klamath River? The Lake water is kept fresh by controlled pumping into the Klamath River through Lower Klamath Lake?

RECENT MAJOR CONTRACT AWARDS

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DC-4132	Central Valley, Calif	June 21	Completion of Nimbus powerplant	Stolte, Inc., Oakland, Calif	$227,789
DC-4140	Cachuma, Calif	June 29	Construction of earthwork, pipelines, and structures for Summerland distribution system.	E. T. Haas Co., Belmont, Calif.	123,100
DS-4141	Missouri River Basin, S. Dak.	do	Three 20,000/26,667-kva autotransformers for Watertown substation.	American Elin Corp., New York, N. Y.	227,780
DC-4143	Davis Dam, Ariz.-Nev	June 9	Construction of Oracle substation and alterations to ED5 substation.	Industrial Electrical Service, Phoenix, Ariz.	100,020
DC-4150	Colorado-Big Thompson, Colo.	June 11	Construction of earthwork and structures for Boulder Creek supply canal, Sta. 664+38.5 to 826+86.	Burks and Co., Denver, Colo	174,272
DC-4151	Columbia Basin, Wash	June 4	Construction of earthwork, pipelines, and structures, including 13 pumping plants, for Area E-6 (Block 45) laterals, sublaterals, wasteways, and drains, East Low canal laterals, Schedule 1.	Cherf Bros., Inc. and Sandkay Contractors, Inc., Ephrata, Wash.	1,676,547
DC-4159	Eden, Wyo	June 14	Construction of earthwork and structures for Eden canal, Sta. 665+40.37 to 891+62.90: and laterals E-7, E-8, and E-9.	McWaters and Bartlett, Boise, Idaho.	174,262
DC-4160	Columbia Basin, Wash	June 7	Construction of earthwork, pipeline, and structures for West canal laterals (Block 86).	Thorburn and Logozo, Seattle, Wash.	288,341
DC-4163	Missouri River Basin, Nebr.-Kans.	June 24	Construction of earthwork and structures for Courtland canal, Sta. 1503+00 to 1581+00, laterals and drains; North canal and laterals: and Ridge canal and laterals, Schedule 1.	Claussen-Olson-Benner, Inc., Holdrege, Nebr.	490,764
DC-4168	Columbia Basin, Wash	June 28	Installation of floor finishes and handrailings for Grand Coulee pumping plant, powerplants, and dam.	L. D. Shilling Co., Inc., Moses Lake, Wash.	127,620
DC-4170	Weber Basin, Utah	do	Construction of Wanship Dam	Utah Construction Co., Salt Lake City, Utah.	2,423,004
DC-4171	do	do	Construction of earthwork, concrete pipelines, and structures, including bifurcation structure, for Davis aqueduct, station 8+36.82 to 935+05.	United Concrete Pipe Corp., Baldwin Park, Calif.	3,902,977
DC-4178	Columbia Basin, Wash	Aug. 18	Construction of earthwork, pipelines, and structures for block 87 laterals, sublaterals, wasteways, and drains, West canal laterals, schedule 1.	Valley Construction Co., Seattle, Wash.	879,305
DC-4180	Avondale, Idaho	July 20	Construction of earthwork, steel pipelines, and pumping plant for Avondale irrigation system, Schedule 1.	Intermountain Co., Boise, Idaho.	154,675
DC-4182	Solano, Calif	Aug. 6	Construction of earthwork, structures, and surfacing for relocation of California State Highway No. 6 (Sign Route 28), Monticello Dam to Capell Valley road.	Stolte, Inc., Gallagher and Burk, Inc., and Lee Stephens, Okland, Calif.	1,663,806
DS-4186	Palisades, Idaho	Aug. 17	Two 96-inch hollow-jet valves with control units and handling equipment for outlet works at Palisades Dam, Item 1.	West Winds, Inc., San Francisco, Calif.	124,389
DC-4188	Gila, Ariz	July 29	Construction of earthwork, concrete lateral lining, and structures for Unit 2, Wellton distribution system.	Morrison-Knudsen Co., Inc., Los Angeles, Calif.	1,168,977
DC-4194	Central Valley, Calif	Aug. 17	Construction of earthwork, pipelines, and structures, including eight pumping plants, for laterals 74.6E, 77.3E-0.01N-1.0W, 77.3W, 78.6W, 79.2W, 80.3W, and 81.4W, and sublaterals, Units 2 and 3, Exeter irrigation district, Friant-Kern canal distribution system.	Cen-Vi-Ro Pipe Corp., South Gate, Calif.	1,376,755
DC-4197	Middle Rio Grande, N. Mex.	Aug. 20	Construction of earthwork, clearing, and structures for rehabilitation of 44 miles of drains, Unit SW-2.	Vega Engineering and Grading Co., Berkeley, Calif.	256,224
DC-4199	Missouri River Basin, Nebr.	Aug. 10	Construction of earthwork and structures for Courtland canal, Sta. 1581+00 to 1740+30, laterals, sublaterals, and drains.	Bushman Construction Co., St. Joseph, Mo.	378,007
	Missouri River Basin, S. Dak.	Aug. 23	Construction of earthwork, 48-inch steel pipe, and inlet structure for Cheyenne River siphon, Sta. 1179+87 to 1198+54.57, Angostura Canal.	Emerson S. Ellett, Inc., Denver, Colo.	45,706
DC-4203	Middle Rio Grande, N. Mex.	Sept. 21	Rehabilitation of El Vado Dam	Korshoj Construction Co. and Claussen-Olson-Benner, Inc., Blair, Nebr.	222,005
DC-4206	Colorado-Big Thompson, Colo.	Sept. 16	Rehabilitation and enlargement of the Erie section of South Platte supply canal, Sta. 10+30 to 315+00.	Emerson S. Ellett, Inc., Denver, Colo.	224,693
DC-4207	Weber Basin, Utah	Sept. 13	Construction of earthwork, concrete canal lining, and structures for Gateway canal, Sta. 48+19.7 to 448+35.8 (Bk), utilizing precast-concrete pipe in siphons, Schedule 2.	Morrison-Knudsen Co., Inc., Salt Lake City, Utah.	1,948,822
DC-4208	Middle Rio Grande, N. Mex.	Sept. 14	Construction of earthwork, clearing, and structures for rehabilitation of 32 miles of drains, Unit BE-2.	Boswell Construction Co., Albuquerque, N. Mex.	127,989
DS-4209	Missouri River Basin, Kans.	Sept. 15	Three 33.33-foot by 39.51-foot radial gates for Webster Dam	Johnson Machine Works, Inc., Chariton, Iowa.	121,463
DC-4219	Eden, Wyo	Sept. 13	Construction of earthwork and structures for West Side lateral, sublaterals, and wasteway.	Sharrock and Pursel, Casper, Wyo.	243,786
100S-192	Minidoka, Idaho	Aug. 13	Thirty deep well pumping units for Group 3 wells	Peerless Pump Division, Food Machinery and Chemical Corp., Los Angeles, Calif.	247,977
100C-193	do	Aug. 18	Construction of earthwork and structures for laterals from Group 3 wells.	James S. Trummel, Middleton, Idaho.	154,981
200C-256	Central Valley, Calif	July 31	Construction of earthwork, rack, ladder, cableway, and 12-kv distribution line for Nimbus fish hatchery.	George Pollock Co., Sacramento, Calif.	272,354

WORK CURRENTLY SCHEDULED

(by December 1954 *)

Project	Description of work or material
Buford-Trenton, N. Dak.	Constructing crib-type retaining wall to stabilize intake channel at Buford-Trenton Pumping Plant. Near Williston.
Cachuma, Calif	Placing bituminous surfacing on access roads, drainage and planting at Carpinteria Reservoir. Near Santa Barbara.
Central Valley, Calif.	Constructing 7.3 miles of 500 cfs earth-lined canal, including 6 culverts, 2 drainage inlets, 3 siphons, 7 prestressed concrete bridges, and 2 checks for Corning Canal, First Section. Near Red Bluff.
Do	Placing pneumatically applied asphalt-cement lining to about 800 linear feet of Madera Canal at Berenda Creek siphon. Near Madera.
Do	Repairing concrete-lined and earth-lined sections of Friant-Kern Canal. Near Orange Cove and Lindsay.
Do	Constructing a gravity and pump turnout from Friant-Kern Canal.
Do	Four motor-driven vertical centrifugal-type pumps each with a capacity of 125 cfs at a total head of 56 feet, for Corning Canal Pumping Plant.
Do	Motor control equipment of the metal-clad switchgear and industrial control type. Rated 2,300 volts. Equipment will consist of one incoming line circuit breaker of 100 mva capacity, and controllers for four 1,000-hp synchronous motors for Corning Canal Pumping Plant.
Colorado-Big Thompson, Colo.	Increasing canal freeboard 18 inches on 2,000 feet of canal, raising concrete lining and timber bridge 18 and 6 inches, respectively, and constructing overflow section for Pole Hill Canal. Fifteen miles west of Loveland.
Columbia Basin, Wash.	Constructing Lateral W-20 (Station 428+50 to Station 792+00), will consist of 12 turnouts, 2 bridges, 1 check, drop and wasteway; 3.4 miles of earth-lined canal varying in bottom width from 32 to 22 feet; 3.5 miles of membrane-lined canal varying in bottom width from 20 to 12 feet. Near Ephrata.
Do	Constructing Lateral W-20 (Station 85+50 to Station 428+50) will consist of 4 turnouts, 1 check and 2 county road bridges; and 6.5 miles of earth-lined canal varying from 36 to 34 feet in bottom width. Near Ephrata.
Do	Constructing 18.4 miles of canals and laterals varying in bottom width from 10 to 2 feet, and appurtenant structures, and installing 3 pumping plants of 3, 9, and 24 cfs capacities, for East Part Block 14 (P-5). Near Mesa.
Do	Constructing 12.9 miles of canals and laterals varying in bottom width from 10 to 2 feet, and appurtenant structures, and installing 6 pumping plants of 4, 8, 9, 9, 9, and 27 cfs capacities, for West Part Block 14 (P-5). Near Mesa.
Do	Constructing Mesa Pumping Plant will include 4 horizontal units of 40 cfs capacity each and steel frame superstructure with metal siding and roof decking, and installing a crane. Concrete substructure to have individual sumps for each pump. Performing earthwork for about 1,200 linear feet of unlined canal lateral with bottom width of 12 feet. Installing about 800 linear feet of 66-inch precast concrete discharge pipe. Near Mesa.
Do	Motor control equipment of the industrial control type. Rated 2,300 volts. Equipment will consist of 4 cubicles for control of four 500-hp synchronous motors and one incoming cubicle for Mesa Pumping Plant.
Crescent Lake Dam, Oreg.	Constructing Crescent Lake Dam will include lowering of outlet channel from lake; removal of present timber-crib dam; and construction of new earthfill dam, outlet works and open-cut spillway. Near Crescent Lake.
Davis Dam, Ariz.-Nev.	Installing at Davis Dam and Power Plant, about 30 miles west of Kingman, Arizona, 3 refrigeration units totaling 23 tons of refrigeration with associated fans and ductwork to provide supplemental cooling and ventilation, and installing partitions and miscellaneous metalwork.
Do	One power circuit breaker for 4-kv circuit, 1,200-ampere, with minimum capacity to interrupt fault current as follows: Interrupting current at 4-kv, 37,500 amperes; short time (momentary) current, 60,000 amperes; interrupting mva at 4-kv, 270. Either an indoor or outdoor type breaker may be furnished, however, a weatherproof housing shall be furnished with the indoor-type breaker. To be installed in Gila Substation.
Do	One 161-kv, 3-PST, outdoor horn-gap switch, horizontal-upright mounted, with manual-gang-operation and one 7.5-kv, 3-PST, 1,200-ampere, outdoor horn-gap switch, horizontal-upright mounted, and with manual-gang operation for Gila Substation.
Deschutes, Oreg	Constructing a 6-room residence, a 20- by 30-foot frame bunkhouse, a 28- by 48-foot steel shop and garage building, and a frame pump house, including installation of utilities, at Wickiup Dam. About 15 miles west of Lapine.
Fort Peck, Mont.	Constructing 8,000-kva, 115/69/12.5-kv O'Fallon Creek Substation will include constructing foundations, furnishing and erecting a small prefabricated-type service building, furnishing and erecting structural steel and installing electrical equipment, major items of which will be furnished by the Government; and furnishing all materials for and constructing about 7.25 miles of 3-phase, single-type, wood pole, 69-kv transmission line. Near Fallon.
Do	Constructing 30,000-kv.-a addition to Williston Substation will consist of modifying and adding to existing steel structures and installing Government-furnished equipment including one 30,000/40,000/50,000-kv.-a, 110- to 69-kv, 3-phase transformer, and 115-kv disconnecting switches.
Gila, Ariz	Constructing about 21 miles of nonreinforced concrete-lined laterals and sublaterals of 45 to 15 cfs capacities including checks, siphons, culverts, drops and turnout structures, and reinforced concrete pipe lines. From about 5 miles west to about 15 miles east of Wellton. Work is for Mohawk Distribution System, Unit 4.
Do	Constructing about 17 miles of nonreinforced concrete-lined laterals of 80 to 15 cfs capacities, including checks, siphons, culverts, drops, turnout structures, floodways, dikes, protective channels, concrete pipe for pipelines, metal gates and hoists, miscellaneous metalwork and railroad and highway crossing for Dome and Wellton-Mohawk Distribution Systems, Unit 2. Near Ligurta.
Do	Installing 2 additional pumps at Wellton-Mohawk Pumping Plant No. 1; 2 additional pumps at Plant No. 2; and 1 additional pump at Plant No. 3. Work will include removal of existing temporary concrete slabs; construction of concrete support piers. Pump suction collars to be embedded in concrete. Near Wellton.
Kendrick, Wyo	Installing Government-furnished supervisory gate control and position indication equipment, water level recording equipment, and telephone facilities at Alcova Dam and Casper Canal headworks, about 30 miles southwest of Casper.
Minidoka, Idaho	Drilling 6-, and 8-, and 12-inch wells to a maximum of 400 feet deep will include furnishing and installing 240 linear feet of 6-, 8-, and 12-inch casing. For North Side Pumping Division, Unit B. Five to 12 miles north of Rupert.
Do	One power transformer, 3-phase, 60-cycle, outdoor, 15,000-kv.-a, 132,000 to 34,500 volts, with tank-mounted 34,500-volt lightning arresters. One power transformer, 3-phase, 60-cycle, outdoor, 2,500/3,125-kv.-a, 33,000 to 4,160 volts, with two sets of tank-mounted lightning arresters. To be installed at Heyburn Substation.
Do	One power circuit breaker, 138-kv, 1,200-ampere, 5,000-mva interrupting rating, 3-cycle opening and 20-cycle reclosing, outdoor type. Four power circuit breakers, 34.5-kv, 600-ampere, 500-mva interrupting rating, 8-cycle opening and 20-cycle reclosing, outdoor type. Five power circuit breakers 7.2-kv, 600-ampere, 50-mva interrupting rating, reclosing, outdoor type. Breakers to be installed at Heyburn Substation.
Missouri River Basin, Minn.	Synchronous condenser for Granite Falls Substation.
Missouri River Basin, Nebr.	Constructing Milburn Diversion Dam 75 feet long, 11 feet high, with radial gates; and headworks with about 2,500 feet of earth canal and 3,500 feet of earth dike, a maximum of 15 feet high. Near Sargent.
Do	Constructing about 10.8 miles of first section of unlined Sargent Canal, bottom width 14 to 15 feet, including 1.3 miles of wasteways, 2 miles of surface drains, and various structures, about 10 miles west of Sargent.
Missouri River Basin, Nebr.-Kans.	Constructing Lovewell Earth Dam, radial-gate-controlled spillway, and rectangular conduit outlet works with radial gate control. Three miles northwest of Lovewell, Kans..
Do	Earthwork, corrugated metal culverts and gravel surfacing for about 2 miles of county road relocation; earthwork, grading and gravel surfacing for improvement of about 2 miles of county road detour; and constructing a portion of reinforced concrete box conduit for Courtland Canal, including excavation and backfill. Near Lovewell, Kans.
Missouri River Basin, N. Dak.	Furnishing and stringing conductors and overhead ground wire on single-circuit 230-kv, steel tower line now being erected under Specifications No. DC-4081, Jamestown-Fargo 230-kv Transmission Line. The line is about 83 miles long. The conductor will be 954,000 circular mil ACSR and the overhead ground wire will be 0.5-inch galvanized steel strand.
Do	Constructing 230/115/69/41.6 Fargo Substation including synchronous condenser installation. Government will furnish major items of electrical equipment.
Do	Constructing 12.47-kv addition to Valley City Substation near Valley City. Government will furnish major items of electrical equipment.
Do	Five 115-kv, 800-ampere, 1,500-mva interrupting rating, 5-cycle opening and 20-cycle reclosing, outdoor type, for Fargo Substation.
Do	Main control boards, supervisory control board, distribution boards, and battery charger for Fargo Sub-

*Subject to change.

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WORK CURRENTLY SCHEDULED—Continued

Project	Description of work or material
Missouri River Basin, N. Dak.—C't	station. Control board line panel and supervisory control board for Jamestown Substation.
Missouri River Basin, S. Dak.	Placing bentonite lining in sections of the main canal and lateral system. Near Hot Springs. Angostura Unit.
Do	Constructing 230-kv addition and modifying existing 115-kv installations at Watertown Substation. Government will furnish major items of electrical equipment. Near Watertown.
Do	Constructing third stage at Groton Substation, 20 miles east of Aberdeen, will involve installing Government-furnished electrical equipment including a 15,000-kv.-a, 3-phase power transformer, breakers, and switches; and constructing foundations, furnishing and erecting structural steel, and installing electrical wiring.
Do	Constructing 12.47-kv additions to Beresford Substation, near Beresford, will consist of placing concrete footings, furnishing and erecting a small quantity of structural steel, performing electrical wiring, and installing Government-furnished 15-kv electrical equipment including a voltage regulator, switches, reactors, lightning arresters, switches, and a breaker.
Do	Moving a frame house from Keyhole Dam, north of Moorcroft, Wyoming, to the Pactola Dam site and constructing a basement and garage, and connecting utilities.
Do	Three 7,500- to 120-volt potential transformers; nine 7,500-volt, 200- to 5-ampere, current transformers; three 4,160- to 120-volt potential transformers; and six 4,160-volt, 1,200- to 5-ampere, current transformers. For Pierre Substation.
Do	Four 14.4-kv, 1,200-ampere, 250-mva interrupter capacity, power circuit breakers. For Pierre Substation.
Do	One 115-kv, 600-ampere, 3-pole, manually gang-operated, horn-gap switch; one 115-kv, 600-ampere, 3-pole, manually gang-operated, disconnecting switch; and thirty-six 15-kv, 1,200-ampere, hook-operated, disconnecting switches; and six 7.5-kv, 1,200-ampere, hook-operated, regulator by-pass switches. For Pierre Substation.
Do	Main control board, distribution boards and battery charger. For Pierre Substation.
Do	Supervisory control equipment for Oahe Temporary Substation.
Do	Fabricated galvanized structural steel for 115-kv single-circuit approach towers to Gavins Point Switchyard. Estimated weight: 80,000 pounds.
Missouri River Basin, S. Dak. and Min.	Main control board addition for Watertown Substation and unmounted equipment for Granite Falls and Watertown Substations.
Missouri River Basin, Wyo.	Constructing the 2,200-foot long and 170-foot maximum height Glendo earthfill dam; concrete spillway; outlet works; powerplant foundation and initial construction of substructure and intermediate structure of power plant; and construction of 7.5 miles of dam access and county roads. Four and one-half miles southeast of Glendo.
Do	Installing Government-furnished pumping equipment in two water supply wells being drilled under Specifications No. 600C-141, near Shoshoni; constructing pump houses over the two wells; connecting pumps to pipelines; and improving about 2 miles of access roads to the wells.
Do	Constructing 15,000-kv.-a Basin, Wyoming, Substation will include furnishing and erecting steel structures and a 20- by 32-foot prefabricated metal control building, and installing Government-furnished equipment including 15,000-kv.-a 115- to 34.5, 3-phase transformer; and 115- and 34.5-kv switching equipment.
Do	Two 34,500- to 120-volt, potential transformers and two 34,500-volt, 400- to 5-ampere, current transformers. For Lovell Substation.
Missouri River Basin, Wyo.—Con.	Two 34.5-kv, 600-ampere, 500-mva interrupting capacity, power circuit breakers. For Lovell Substation.
Do	Six 34.5-kv, 600-ampere, hook-operated, disconnecting switches with hook-operated grounding blades; nine 34.5-kv, 600-ampere, hook-operated, disconnecting switches; and one 115-kv, 600-ampere, horn-gap siwteh, manually gang-operated. For Lovell Substation.
North Platte, Wyo.-Nebr.	Constructing 2.4 miles of buried asphalt membrane lining for Fort Laramie Canal. About 15 miles southwest of Torrington, Wyo., in Goshen County, Nebr.
Orland, Calif	Constructing 2,400 linear feet of 24-inch nonreinforced cast-in-place concrete pipe. Near Orland.
Palisades, Idaho	Two motor-driven, vertical, turbine-type pumps each with a capacity of 4,000 gpm at a total head of 30 feet; one motor-driven vertical pump with a capacity of 3,700 gpm at a total head of 11.5 feet; one motor-driven, vertical sump pump with a capacity of 25 gpm at a total head of 20 feet; two motor-driven, gear-type, oil pumps with capacities of 50 and 20 gpm at a pressure of 75 psi. For Palisades Power Plant.
Do	Controls for 96-inch ring-follower and outlet gates at Palisades Dam.
Do	Two motor-driven, single-stage air compressors each with a capacity of 100 cfm at a pressure of 100 psi and one motor-driven, two-stage air compressor with a capacity of 20 cfm at a pressure of 350 psi for Palisades Power Plant.
Do	One 12,000- to 480-volt, 3-phase, 60-cycle, double-ended, 1,000-kva each end, unit substation for Palisades Power Plant.
Provo River, Utah.	Placing earth and clay lining for 0.75 mile of Weber-Provo Diversion Canal. Near Kamas.
Riverton, Wyo	Placing asphalt membrane lining in various reaches of the Pilot Canal, and Wyoming, Pilot and Lost Wells Laterals. Near Riverton.
Do	Constructing one mile of open drains and about 3.5 miles of closed drains. All materials to be furnished by contractor. About 25 miles north and west of Riverton.
Weber Basin, Utah.	Constructing Weber Aqueduct from outlet of Gateway Tunnel to southern limits of Ogden will include earthwork, steel pipelines, earth equalizing reservoir and structures; 48- and 42-inch steel pipe with heads varying from 0 to 400 feet about 4.4 miles long; appurtenant concrete structures, valves, and meters. (Alternate invitation to be issued for this work listing concrete pipe lines.)
Yakima, Wash	Constructing 12.3 miles of 500 to 356 cfs Kennewick Main Canal, Division No. 2, 0.6 mile of which will be concrete-lined, will include drainage structures, turnovers, checks, bridges, and 11 reinforced concrete siphons.
Do	Constructing 10.1 miles of Kennewick Main Canal, Division No. 3, varying in bottom width from 14 to 5 feet, and appurtenant structures, will include turnouts, drainage inlets, box culverts, checks, siphons, timber bridges, including metal gates and hoists, and miscellaneous metalwork.
Do	Constructing 0.57 mile of main canal varying in bottom width from 14 to 8 feet, and appurtenant structures, including siphon, spillway, and wasteway, and constructing the Amon Pumping Plant of 20 cfs capacity, pumping plant wasteway, and box culvert under railroad. Near Kennewick.
Do	One hydraulic turbine driven horizontal centrifugal-type pump with a capacity of 20 cfs at a total head of 222 feet (effective head on turbine 65 feet) for Amon Pumping Plant.
Do	One carbon-dioxide fire extinguishing system for protection of oil storage and oil purifier rooms at Chandler Power and Pumping Plant.

The Reclamation Era

February 1955

IN THIS ISSUE:

DISASTER AVERTED

COMMISSIONER DEXHEIMER REPORTS TO THE CONGRESS

Official Publication of the Bureau of Reclamation

The Reclamation Era

FEBRUARY 1955 Volume 41, No. 1

IN THIS ISSUE . . .

DESIGN AND ILLUSTRATIONS by Drafting and Graphics Section
Bureau of Reclamation, Washington, D. C.

J. J. McCARTHY, Editor

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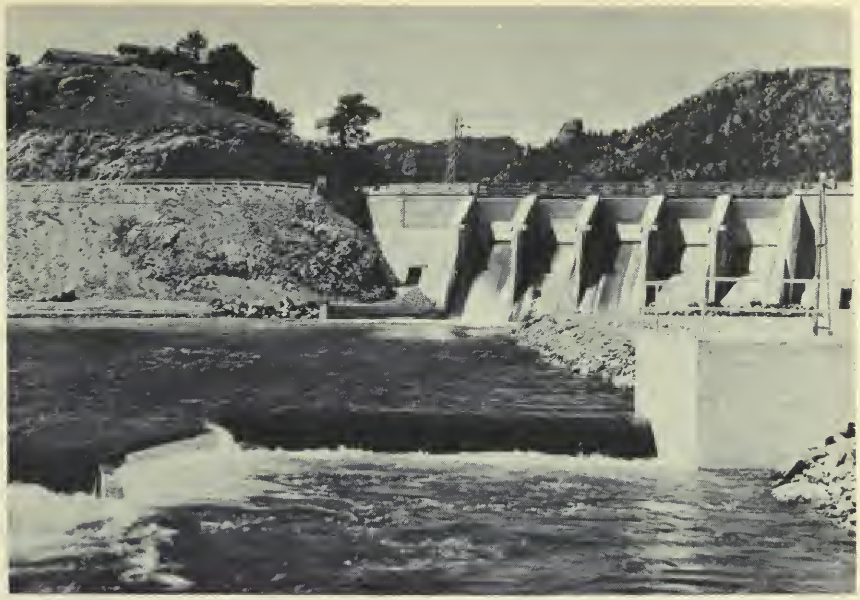
* * *

30 Years Ago in the ERA

DON'T MINE THE FARM

Farming is not mining. A miner is not expected to put anything back. A real farmer puts back whatever is required for soil improvement. He does whatever is needed to strengthen the weakest link. Even if the nitrogen content should remain stationary as a result of fixation by bacteria on the roots of alfalfa, selling the foliage off the farm in the form of hay removes other plant foods. That which should be returned goes to enrich the farms of others. Feeding crops on the farm retards depletion. Whether manures are a food or a health restorer, they are necessary, and they turn the trick when they become incorporated with the soil.

OLYMPUS DAM—outlet works in background. Foreground shows gauging station and measuring weir in Big Thompson River.



DISASTER AVERTED

by DON F. MARTIN, formerly Field Liaison Officer, Region 7, Headquarters Denver, Colorado

THE YEAR 1954 DAWNED bright and clear in northern Colorado; and it continued that way, day after day, week after week, month after month.

Northern Colorado was in the withering embrace of its first serious drouth in 20 years. Hundreds of thousands of acres of one of Colorado's most important agricultural areas lay sweltering under the constant sun. The towering Rockies loomed dry and snowless over the sunbaked prairies below. Streams normally fed by the mountains' melting snowpack dwindled to trickles.

There might have been disaster, but there wasn't because a dream of 75 years had come true. The Colorado-Big Thompson Project, dramatic transmountain water diversion project, 60 years a hope and a dream, and more than 16 years in the building, was ready to deliver water to the bone-dry farms in the huge Northern Colorado Water Conservancy District extending from the foothills of the Rockies eastward through the South Platte River Basin to the Colorado-Nebraska State line.

Into this drouth-wracked area, the Colorado-Big Thompson Project poured 300,352 acre-feet of water—water which had been stored in project reservoirs, transported beneath the Continental Divide through a 13-mile-long tunnel, three-quarters of a mile below the crest of the Rockies, and finally distributed to the lands through a system of canals interconnected with the privately developed and privately operated irrigation systems spider-webbing northern Colorado.

The Northern Colorado Water Conservancy District served under the Colorado-Big Thompson Project comprises an area half as large as the entire State of Delaware—615,000 acres of cultivated land.

Across this broad expanse flow the streams which give it life, the river and creeks to which early settlers turned for water when they found that precipitation was too limited to provide for the optimum production of crops. The land is rich and fertile, but to pour forth its bounty it must have irrigation.

Through the latter part of the 19th century, scores of private irrigation systems were developed, depending upon natural stream flow for supplies. It soon became apparent, however, that under the extensive development, additional supply was needed during the mid- and late-season period when spring runoff was over and the streams were running low. This led to a period of reservoir construction to hoard the heavy spring flows for use later in the growing season.

Even this was not the answer, however. The natural water supply was overappropriated. Shortages of irrigation water supplies frequently limited crop production to a serious degree. The

more farsighted residents of the area looked westward toward the mountains and believed they saw in that direction the answer to their water problems: Just across the Continental Divide on Colorado's Western Slope water was plentiful, actually in surplus.

But the granite peaks of the Rockies lay as a 14,000-foot barrier to tapping the Western Slope waters. This was the problem the Colorado-Big Thompson Project was designed and built to solve. A system was constructed on the Western Slope to collect surplus waters from the upper Colorado River Basin and to guarantee water rights and needs of Western Slope users.

The Alva B. Adams Tunnel was driven under the Divide to bring the water from west to east. And then a series of hydroelectric generating plants were constructed to use the more than 3,000 feet of natural head between the east portal of the tunnel and the farmlands below.

These plants pour out the energy needed by farms, cities, industries, and other users in a wide section of Colorado. Revenues from sale of this energy are paying a major portion of the $159.8 million dollars the project will cost when it is finally completed a year or two hence.

This is the project then which had its baptism by fire in 1954, even before all the physical works were completed. Soil moisture content was shrunken to only about 15 percent of normal when the 1954 planting season began. Precipitation over the broad area served by the project had dwindled for months so that records showed it was down to less than 40 percent of normal in some sections and, at best, 50 to 60 percent in others. Natural runoff during the spring of 1954 was only 40 percent of the normal.

The one brightening factor as the drouth-dominated spring season began was the presence of a near-capacity supply of water in the project's storage reservoirs. In storage in the project system on May 1 were 532,572 acre-feet of water, exclusive of the Green Mountain replacement reservoir which then held 45,856 acre-feet to guarantee Western Slope needs.

In private storage in the service area there were 115,200 acre-feet additional, somewhat under the 20-year record average of 126,000 acre-feet. These were the reserves upon which the farmers and the communities of northeastern Colorado had to

Continued on page 18

At left: GRANBY RESERVOIR. Lower left: East portal of the ALVA B. ADAMS TUNNEL. ***Photo by Norton T. Novitt.*** **Below: Irrigating beets.**

MORE DRY YEARS AHEAD

By I. R. TANNEHILL

Editor's Note: We are indebted to *Country Gentleman,* now known as *Better Farming,* for the following article which appeared in the September 1954 issue of *Country Gentleman,* copyright, 1954, by the Curtis Publishing Co.

DUST BOWL SCENE near Liberal, Kansas (1936). ***Photo by Arthur Rothstein, U. S. Department of Agriculture.***

THE AUTHOR—*Mr. I. R. Tannehill was formerly Assistant Chief of the U. S. Weather Bureau, a position from which he retired last November 1, and is a recognized world authority on weather. He is the author of "Drought, Its Causes and Effects," an outstanding work on the subject, as well as several other important books on weather. He was asked by "Country Gentleman" to outline the long-range prospects for rainfall in the United States. In this article he gives his ideas regarding the general weather outlook for the next 20 years in attention-compelling terms. His statements are his own and are not offered as an official opinion of the U. S. Weather Bureau.*

The unusually hot and dry weather of the past 3 years has raised a number of questions in the minds of farmers and a widespread concern over our water supply. Does it indicate that this country is in for a hotter and drier climate as some say? Will the recent droughts be repeated? Or will you have abundant moisture for good crops in the next several years? And what are the longer-range prospects for the future? Here are your answers in general terms:

To put it in a few words, the country is now in a dry cycle that is likely to hold on for 7 or 8 years longer. Not all of these years will be dry, and none of them is apt to be dry in all parts of the country. Two or three of them are apt to be fairly wet in most of the States but, as a whole, the block of years extending to 1962 will average considerably drier than normal. In several of these years there will be dust blowing again in the Southwest, especially in the late winter and early spring. Many parts of the country will continue to be plagued by drought at one season or another, most likely in the warmer part of the year.

How do we come to these conclusions?

What we know about the weather of the past is an index to the weather of the future. Year by year we add to this knowledge. A few of our weather records run back into the first quarter of the 19th century, but these records are mostly in the East. It was not until 1886 that we had a suf-

ficient number of observers around the country to give a reliable picture of the national rainfall.

As this record gets longer—it now exceeds two-thirds of a century—we begin to see the pattern of changes around the seasons, through the years and across the great length and breadth of our country. In this pattern there are broad swings up and down in the national rainfall. Each time the curve changes you read stories, as you probably have lately, about a permanent change in our climate.

After the droughts in and for some time after the Civil War period there was more abundant rainfall, especially in the years from about 1875 to 1885. This led many people to believe that increasing cultivation of the soil in the Prairie States had changed the climate. But a big disappointment came with the dry cycle, which began in 1886 and became disastrous in the 1890's. Since that time these great swings in the national rainfall have continued and are plainly evident in the records of the 20th century. What do they look like?

The records show that dry cycles began in 1886, 1910, and 1930. Another one started late in 1951. Wet cycles began in 1898, 1919, and 1941. These are averages, of course, and in each of these cycles there were some wet and some dry years. But in the dry cycles there were more dry years and the droughts were worse than in the years of the wet cycles.

This period of years from wet to dry and back to wet again ranges from 20 to 24 years, but averages 22 years. It corresponds with what is known as the "Hale double sunspot cycle," after its discovery in 1908 by an astronomer named George Hale. Just how this solar influence causes these changes in our weather no one at present knows for sure. But it is a curious fact that these changes to dry and back again to wet start about 3 years before each low point in sunspot activity.

For example, the dry cycles began a few years before the sunspot minima of 1889, 1913, and 1933. The present one is not definitely determined yet, but it is likely that 1954 will prove to be the minimum sunspot year.

In these dry cycles in the United States, the rainfall follows a complicated pattern, but it has certain broad features that are just the reverse of the variations in the wet cycle. The dry cycle begins rather abruptly—as it did in late 1951—and continues off and on for 2 to 4 years.

This is followed by one or two wet years and then in the sixth or seventh year another drought of about 2 years sets in. Looking back through the records, we see that 7 years after the first dry spell began in 1886, a second drought came in 1893 and 1894. Actually, the dust began to blow in the summer of 1892.

The driest year of record, for the United States as a whole, was 1910, and it was followed by a drought that began in 1916. The big droughts of the 1930's began in the eastern half of the country in 1930, and 6 years later we had one of the worst drought years in the Middle West.

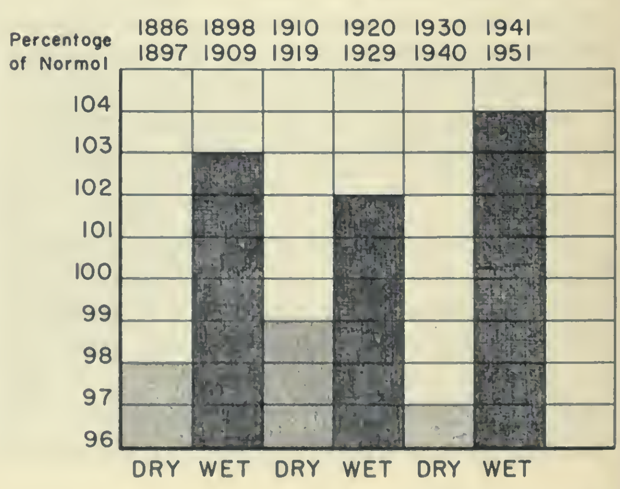
On this basis, we can look for another drought to develop in 1957 or 1958 and continue for about 2 years.

Between these pairs of droughts in the dry cycles, there has been one or two wet years. On the whole, the years 1891 and 1892 were wet; 1915 was very wet. You'll recall that 1935 was a wet year, and it should be wet again in 1956.

On the other hand, the wet cycles have few droughts and they are rather mild. We can look for them about midway of the wet cycle. You remember that we had such a mild drought in 1946 and into 1947. In the next wet cycle, beginning in the 1960's, a moderate drought is likely near 1969.

These calculations are quite generalized, but they indicate in a broad way the prospects ahead in regard to water supply, soil moisture, and farm production. They will help to point up for you the relation between variations in the sun's radiation and rainfall, which was discussed by Dr.

Continued on page 12



GROWING PAINS

SCHOOL NEEDS OF AN IRRIGATED AREA

by RUSSELL M. ESVELT and JOHN A. PORTER, Graduate Students in School Administration at the State College of Washington, engaged in Research Studies on the Columbia Basin Project under a Kellogg Foundation Grant

The "Jackrabbit Derby" is the feature event of an annual celebration staged in Quincy, Wash., a mushrooming community in the Columbia Basin Project area. It commemorates the time, just a few years ago, when these racehorse bunnies were the most numerous inhabitants of the semiarid land. Their presence is a reminder of the great change taking place with the development of an irrigation project.

Now that people are replacing jackrabbits, the character of social problems in the Columbia Basin is changing as rapidly as the landscape. The irrigation farmer's young progeny, within a few years, will outnumber the young jackrabbits according to present indications. And therewith lies our story, of people working together to insure their children in a pioneer area of the same educational opportunities offered in stabilized, well-developed communities.

The Columbia Basin Project is judged the most extensive ever attempted by the Bureau of Reclamation. The first major phase of the project is currently converting 500,000 acres of sparsely populated land into an area of intensive farming and thriving communities. The development schedule calls for this accomplishment by 1960. Taking place in the relatively short space of 10 years, the rapid pace of development poses problems that require unusual attention and effort. Where arrangements and facilities existed for community services in prereclamation days, the growing needs of expanding communities quickly make them totally inadequate to handle the load.

Schools for the new crop of youngsters have been a critical problem since early in the development. Rapidly rising enrollments demand a series of expansions in school districts that as yet have received little increase in taxable wealth.

In 1946 the total area had less than 1,700 pupils in its schools. An enrollment of over 20,000 is predicted by 1962. The Moses Lake schools have already grown from 500 to 2,700 pupils, and expect to reach 5,300; Lower Crab Creek, with a 1950 enrollment of 15 children, estimates 2,400.

School districts were poorly equipped to cope with such a growth problem. The public school is hardly noted for its surplus of ready cash for emergencies. The horde of youngsters knocking at the door has cleaned the cupboard in a hurry. There is little possibility of replenishment as the children keep right on coming.

To their everlasting credit, school officials at an early date recognized the need for cooperative action. In 1947, they met and formed a federation called the Columbia Basin School Development Association. This organization, whose membership includes all school board members and superintendents in the affected area, has remained active ever since, and has been the coordinating force for nearly all action taken. An executive council consisting of school superintendents meets monthly, with meetings of the entire membership called as needed.

During the early years of its existence the group concerned itself largely with organizing support from outside agencies. The Bureau of Reclamation, of course, figured to a considerable degree in all aspects of planning. Bureau officials are fully aware of the importance of school facilities to the orderly settlement of the irrigation project. Their cooperation has been invaluable in providing data for growth patterns and total effect on each school district, as well as the entire project area. They also granted, under provisions of Federal law, considerable financial assistance for school building and operating costs attributable to the construction and operation phase.

With first water delivery scheduled for 1952, only a small proportion of the ultimate population was on the scene by 1951. These folks, the long-time residents and first newcomers, needed real help to plan for and provide schools for the greatly increased enrollments just around the corner.

The State College of Washington recognized the impact of the Columbia Basin Project on the schools of the Basin. For assistance in the problem, it made application to participate in the Cooperative Program in Educational Administration, a project endowed by the Kellogg Foundation and intended to provide research and in-service training in school administration. Under the direction of Dr. Zeno B. Katterle of the college, a Kellogg project was instituted, entitled "School Administration and Community Planning Technique in Rapidly Growing Areas." In November of 1951 the Columbia Basin School Development Association formally requested the assistance of the Kellogg project in the school districts' efforts to keep pace with their school needs. Since that time the association and Kellogg project representatives have met regularly and worked closely together.

From its beginning, this cooperative project has sought to bring local people and groups into the study of and planning for their school needs. The leaders have tried to emphasize participation and responsibility by the community as an important factor in the development of the irrigation project. However, outside help and support are needed. Cooperating agencies include Bureau of Reclamation personnel, particularly Jim Berkey (now with the Atomic Energy Commission at Richland, Wash.), Herb Simison of the Project organization at Ephrata; the office of the State Superintendent of Public Instruction; county officials, especially county school superintendents; and on occasion various other local and regional groups.

Local responsibility has been encouraged by the formation of lay committees within the individual school districts. These committees are made up of citizens representing a cross-section of the com-

This EPHRATA SCHOOL housed all grades before Reclamation development. Photo on preceding page shows EPHRATA'S NEW HIGH SCHOOL already overcrowded.

munity. Their purpose is to assist the school board by interesting as many people as possible in studying the needs of the local schools. The committees serve to develop among more people an understanding of school problems, and to enlist the support and cooperation of all the people in building and improving the school program.

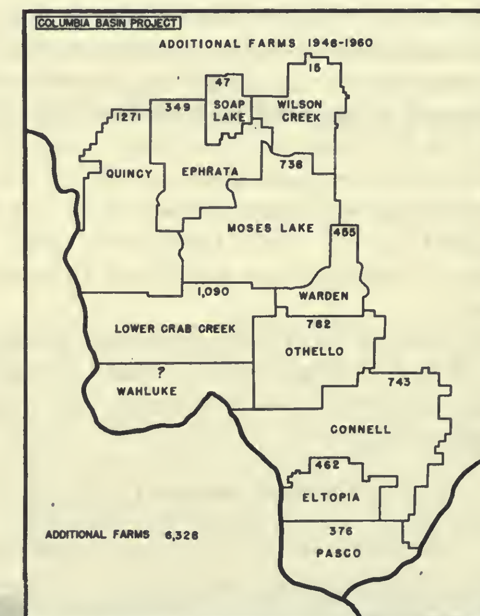
The Kellogg project is providing the services of two graduate students at the State College of Washington, working as interns in school administration. Their program of work, which will be continued until 1955, has provided information as follows:

1. School enrollment projections for each district, including farm-child and rural-urban ratios.
2. Assessed valuation estimates, with techniques for working them out.
3. Surveys of community attitudes toward schools.
4. Community participation in planning techniques and long-range programs.
5. Analyses and studies of school site locations.
6. Continuing studies for refinement of estimates of enrollment and financial ability.

The underlying purpose of the work of the Kellogg project has not been to furnish answers to the many school problems of the Basin school districts. Instead, it has tried to provide information and suggest methods whereby districts may work out their own solutions. People who are interested in their schools will, if given encouragement, take time to find out what is needed to have good schools, and then will work to get them. State and Federal agencies have responded to applications for financial assistance—applications backed by factual data and united support. Community understanding has resulted in excellent local support for the school program.

Despite the enormity of the task of keeping up with their school needs, Columbia Basin communities show promise of leaving no stone unturned to get it done. Already they have provided for over 4,000 new pupils, tripling their original school facilities. Latest estimates indicate a need for 500 more classrooms during the next 8 years to care for 15,000 additional pupils.

The outcome may well be modern, well-equipped school systems, adapted to the needs of an agricultural economy. The American tradition of equal educational opportunity for all, in the pioneering frontier as well as in its productive aftermath, is being recreated in the public schools of the Columbia Basin Project. The important thing to remember, though, is that it isn't just "happening." *Planning*, *determination*, and *effort* on the part of many people are the factors that *give an excellent prospect for success.* # # #



Below: BEFORE and AFTER—Lower left, abandoned dry-land farmstead on Columbia Basin Project (H. E. Foss photo). Lower right, typical farmstead under irrigation on the project. Immediate right: map of SCHOOL DISTRICTS on the project and farms.

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ELECTRIFYING THE SOIL

By JOSEPH P. COLLOPY, Engineer, Region 6 Headquarters, Billings, Montana

Much has been said about the rapid increase in the use of electricity on the farms and ranches in the United States during the last two decades or so. Electric power lines are now making possible the advantages of electric power for lighting, cooking, heating, and countless motor driven devices increasing the efficiency of the available manpower. However, there are new fields opening up for the use of electric power in connection with agricultural activities. One of these is the application of electric current to the soil in different ways for the purpose of securing many varied and useful results.

Some work, especially in Europe, has been done in this field dating back several years. However, the work undertaken during the past three years by personnel connected with the Bureau of Reclamation, Billings, Mont., has greatly increased the interest in the possible practical use of these processes. Although this work has been encouraged by Supervising Engineer C. T. Hinze as far as his authority permitted, much of the investigations has been done on the off time of the interested employees. Some work has been conducted by the Soils Laboratory under the Assistant Commissioner and Chief Engineer in Denver.

The purposes for which an electric current has been passed through soil by these Bureau of Reclamation employees are many and may be divided as follows:

1. The reclaiming of bogged and salted agricultural areas.
2. Increased plant growth.
3. The stabilization of soil for such purposes as canal lining, roadways, excavation activities.
4. The control of animal life within the soil.

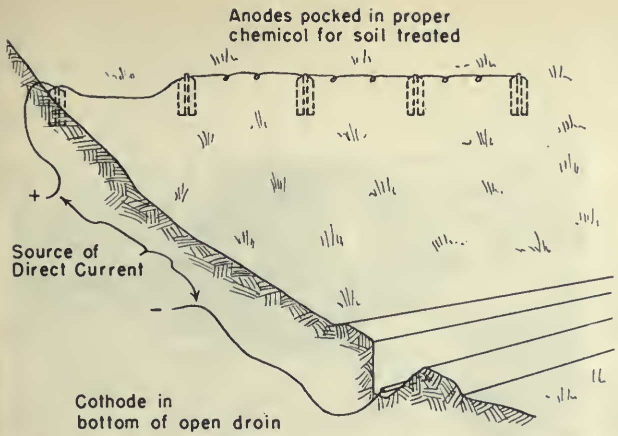
Reclaiming of Agricultural Land

Some of the most amazing results were secured in the reclaiming of bogged and salted areas. Figure 1 is a photograph of a bogged area covered by white and black alkali. This photograph was taken on June 19, 1952. The area had not produced any crop for 19 years. Figure 2 shows the type of cover on this area about 50 days later. This cover consists of a heavy growth of grasses and sweet clover. The cost of the current required was $2.40 per acre at retail rates.

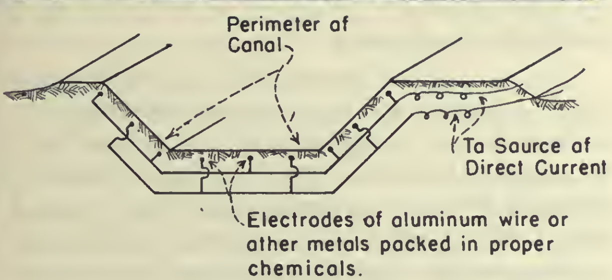
The sodium content of the drain water increased over 20 times, or from 1,518 p. p. m. to 37,092 p. p. m., after the current had been applied for a short time and the sodium content of the soil was reduced enough to warrant the placing of excluded land in payclass according to Bureau of Reclamation standards. One arrangement used for applying current is shown in figure 3. The effects on the sides of the drain ditch caused by more water being

① BEFORE TREATMENT

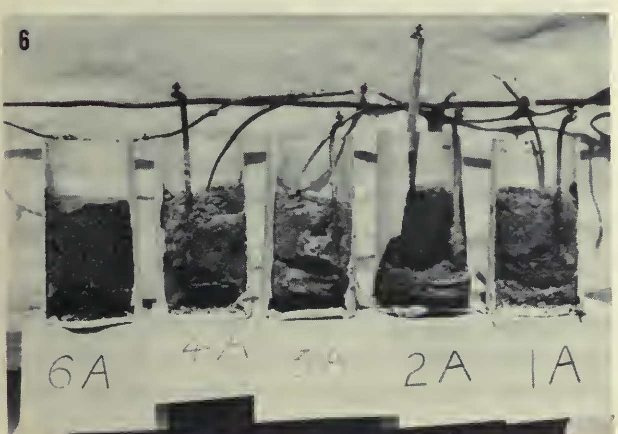
② AFTER TREATMENT



3. Stabilization of soil along open drain



5. An arrangement of electrodes used for canal lining



pulled through are shown in figure 4. The cathode consisting of a copper wire is in the bottom of the drain for a distance of about 500 feet in the foreground and is pulling water through the right-hand bank. The alfalfa in the area treated averaged about 8 inches higher than that in the untreated areas and matured a week earlier.

Other areas treated did not show such outstanding results. More research is needed regarding methods, costs and results before the practical applicability of such treatment can be determined.

Lower Cost Canal Lining

The loss of water through the wetted perimeter of irrigation canals and laterals is always a matter of concern not only on account of water shortage but also the seepage problem that is created. The lining of these canals is a costly process and a constant effort is being carried on by the Bureau of Reclamation and other interested parties toward reducing this cost.

Some work had been done in the past in connection with stabilizing soils around piling in order to increase their bearing power by using electric current and aluminum electrodes. An application of this theory, with modification, has been used by Bureau of Reclamation personnel for

ILLUSTRATIONS explained in text.
Please consult figure numbers.

Figures 8 and 9—Two types of equipment used for providing electric current. Figure 10—A field test pertaining to soil stabilization. Stabilization is shown increasing toward the right or toward the cathode. *All photos by the author, Joseph P. Collopy.*

lining canals. Some promising results have been obtained at low costs.

Several arrangements of electrodes have been tried with various spacings. Different materials have been used for cathodes in combination with the aluminum anodes. The electrodes used have been in such forms as sheets, wire, rods, etc. The type used depends largely upon the conditions encountered and the results desired. Various chemicals such as sodium chloride or common salt were placed in the water and definite results were obtained. An arrangement of electrodes that has given satisfactory results is shown in figure 5. Different types and arrangements of electrodes and chemicals were tried in the laboratory, one set of which is shown in figure 6. Unit 6A was a check unit and received no treatment. The location of the first field experiment is shown in figure 6A where a small ditch was treated. The permeability was reduced from one foot per hour to less than one inch per hour using a small battery charger. Figure 7—Alkali field after treatment.

Drainage Construction

Various systems are being tried at the present time for expediting the construction of deep, subsurface drains through bogged and unstable soils. Electrodes of various types have been placed on the center line or on either side of the proposed drain. Care must be taken in this operation not to permanently close the soil pores. The results obtained show promise, but a system has not been developed that can be recommended for field construction.

Control of Life in the Soil

The effect of an electric current upon fish in the water or angle worms in the soil is well known. The Bureau of Reclamation people at Cody, Wyo. have carried this process a step further. Recent work in connection with the control of insect and microbiological life within the soil has proven to be interesting and perhaps of some significance if time proves that the effect upon such pests as nematodes and maggots is of importance. The

Continued on page 23

COMMISSIONER DEXHEIMER REPORTS TO THE CONGRESS

At the request of the Chairman of the House Committee on Interior and Insular Affairs, Reclamation Commissioner W. A. Dexheimer recently made a report to the Congress on The Growth and Contribution of Federal Reclamation to an Expanding National Economy. A limited number of copies of this report, printed by the Interior and Insular Affairs Committee, and identified as Committee Print No. 27, are available upon request to the Commissioner of Reclamation (Attention Code 910), Washington 25, D. C.

In brief this report shows in part that—

1. Reclamation has constructed or rebuilt facilities to furnish a full or supplemental irrigation water supply for 7.1 million acres of irrigable land. This translates into 125,000 family-size farms and an additional 125,000 suburban units.

2. Crop production in 1953 from 69 reclamation projects or major divisions was valued at $785.9 million and the cumulative value of crops produced from 1906 to 1953 totals almost $10 billion.

3. Net power revenues in fiscal year 1954 from 29 power plants now in operation, after deductions for annual operation, maintenance, and replacements, totaled $33.9 million, and the total of all net power revenues returned to the Federal Treasury through June 30, 1953, amounted to about $225.9 million. Net power revenues during the next 50 years from 1953 at the level of fiscal year 1954 could return an additional $1,692.5 million to the Treasury.

4. Irrigation and municipal water repayment contracts will return $691 million, of which $108.9 million had been paid to June 30, 1953. While making construction account payments, the water users have paid operation and maintenance charges as they have become due. This will continue. Additional returns will accrue through water-sales-type contracts.

5. Potential returns to the United States Treasury from irrigation and municipal water users during the contract repayment period, plus the net power revenues from the presently operating facilities at the fiscal year 1954 level for the next 50 years will aggregate $2.6 billion, of which $334.8 million had been paid in on June 30, 1953. Power plants under construction will, when completed, add materially to these potential returns.

6. Federal tax revenues since 1916 from reclamation areas which may be attributed to Federal reclamation developments now stand at more than $3 billion. This sum alone exceeds by 25 percent the total cost of all Bureau-constructed projects to date.

7. Income to reclamation-project farmers and farmworkers totaled $550 million in 1953, or a cumulative income since 1906 of $6.8 billion.

8. Income to nonfarm urban areas in the environs of reclamation projects in 1953 amounted to about $786 million and aggregates almost $10 billion.

9. Annual business activity attributed to fishing, hunting, and other recreation at reclamation res-

ervoirs is estimated at about $33 million annually.

10. Western population has increased at a much greater rate during the last decade than has the population of the Eastern States. For example, the population of the 17 Western States increased 25.8 percent between 1940 and 1950 while the 31 Eastern States gained only 11.5 percent.

11. Per capita retail trade in the Western States exceeds that of the Eastern States.

12. Reclamation project construction results in increased shipments of materials, supplies, and equipment from east to west during construction.

13. With reclamation-project development, business activity as reflected by railway freight shipments increases from east to west and from west to east.

14. The value of plant, property, and equipment of all Reclamation projects, both completed and under construction to serve irrigation, power, municipal water, flood control, fish and wildlife, pollution abatement, salinity control, navigation, and other public uses totaled $2.4 billion on June 30, 1953. This resource development expenditure over a period of more than 50 years is less than 4 percent of a single year's national budget. The fiscal year 1954 appropriation for reclamation construction was ¼ of 1 percent of the national budget. # # #

KLAMATH TRANSFER EFFECTIVE JANUARY 1

Members of the Klamath Irrigation District on November 11, by a majority vote, agreed to assume responsibility for the operation and maintenance of seven main canals, the drainage system, and several pumping plants within the District.

J. P. Elmore, the Project Manager, explained that of the original $2 million-plus owed by the Klamath District to the Bureau of Reclamation, less than $450,000 remains to be paid. The Bureau will continue the administration of the District and Bureau personnel will continue to inspect the transferred facilities. The costs for these services will be borne by the District.

This latest transfer of project facilities is in keeping wtih the policy of the Department of the Interior and the Bureau of Reclamation. This policy has been and continues to be one of encouraging the water users to operate and maintain their own distribution system as soon as possible. •

More Dry Years

Continued from page 4

Charles G. Abbot in the article "Another Drought Year Ahead?" in the September 1953 issue of *Country Gentleman.*

Moreover, they have an interest beyond this country, for it is a further curious fact that when wet cycles begin in the United States, the reverse or drought starts in the equatorial regions or in the Southern Hemisphere, and tends to spread northward into India, China, and Southeast Europe, sometimes including the Russian Ukraine.

Droughts in the years 1919 and 1921, beginning in Africa, culminated in a famine in the Ukraine in 1921. Also, there was a great Southern Hemisphere drought in the early 1940's at a time when the sunspot minimum was approaching and a wet cycle was becoming established in the United States.

The really significant thing is that these records indicate a definite alternation between wet and dry periods, and not a gradual drying out of the climate of the United States. Looking forward, we can expect in this same pattern a wet cycle to begin early in the 1960's—likely 1963—and at the same time a drought in the southern part of the world. Similarly, another dry cycle in this country should begin near the middle of the 1970's, probably in 1975.

While there is no need to be unduly alarmed because we are in a dry cycle, since a period of years with more rain will most certainly follow in the 1960's, there is one fact we should keep in mind. The population continues to increase and the use of water, in the home and for industrial and farm uses, climbs steadily and rapidly. So each dry cycle finds us in a worse predicament.

The most dangerous feature of these broad variations in the rainfall is the reassuring effect the intervening wet periods have upon us. Unless this pattern runs out, we will come into the early 1970's with frequent floods in the rivers, high water in the Great Lakes, and good rainfall in the high plains and marginal lands, with little thought about the problems another dry cycle will bring. Then will be when real trouble is just around the corner.

By that time our water demands may make the supply critical even in good rain years. What will we do when the great drought of 1975 settles down upon us? That's your question. # # #

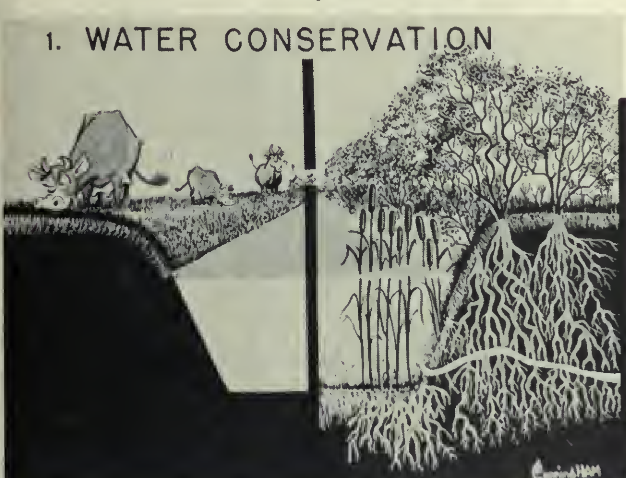
Weed Warning

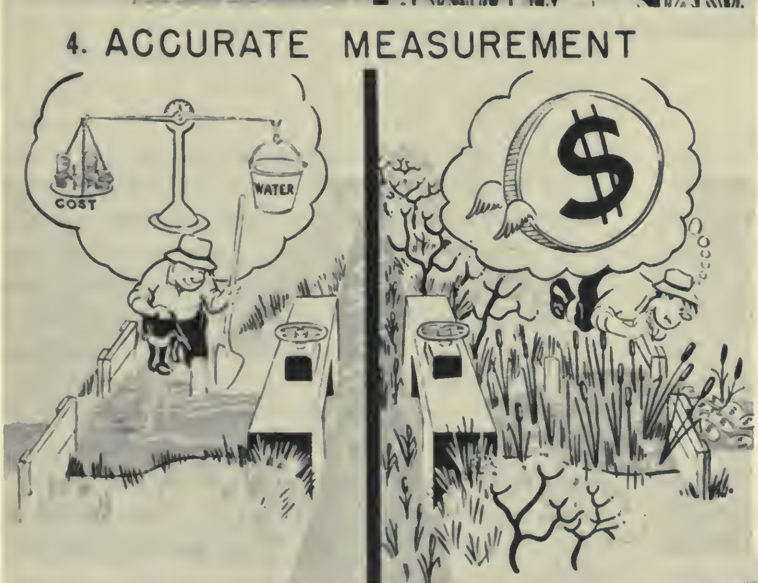
by JOHN T. MALETIC, Regional Soil Scientist, With Illustrations by
DAVID CUNNINGHAM, Illustrator, Region 7

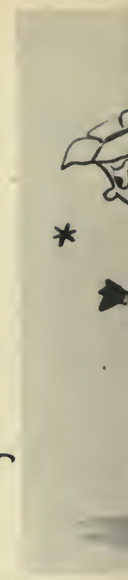
Weeds on irrigation systems in the 17 Western States cost the farmer $25,000,000 annually. How do weeds cause such a tremendous loss? . . . They use water, increase operation and maintenance costs, reduce crop yields, and increase the cost of farming. Let's glance at the culprit at work . . .

(1) WATER CONSERVATION. Weed control achieves water conservation. 150,000 acre-feet of water are consumed by weeds annually on Reclamation-built irrigation systems. Look at the contrast . . . shallow-rooted grasses use small amounts of water in comparison to the cattails and willows on the weedy ditchbank. Old root channels provide a fast getaway for the water in the canal. Other water losses occur because the water weeds increase the height of water in the canal. This action increases the evaporation loss and causes more water to percolate through the less compacted upper section of the ditchbank.

(2) BETTER DELIVERY. A weed-free ditchbank allows a smooth flow of water through the ditch, assuring delivery of the correct head of water to the irrigator. In the weedy ditchbank, water velocities are slower. Enroute to the irrigator, water is used by the weeds. As a result, it takes longer to make deliveries and he gets less water for his crops.





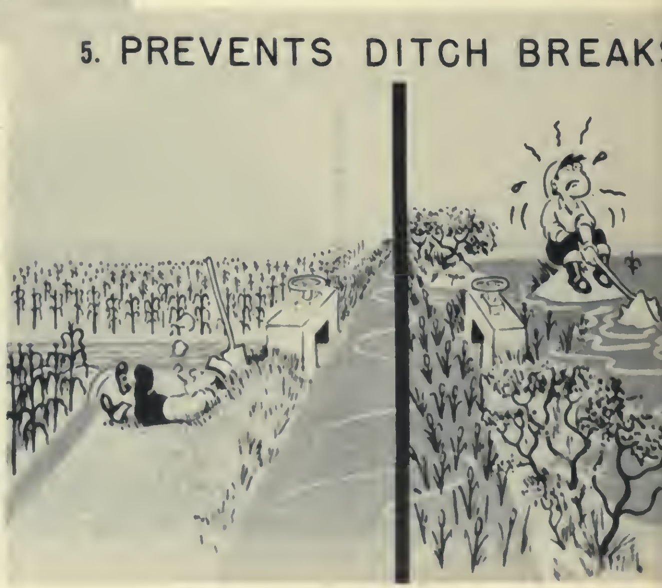


(5) PREVENTION OF DITCH BREAKS. A weed-free ditchbank is less likely to fail than a weedy ditchbank. To guard against costly breaks, clean up the ditchbank and plant adaptable grasses.

(6) (7) (8) (9) BENEFITS FARMERS. Weed control on the irrigation system pays off on

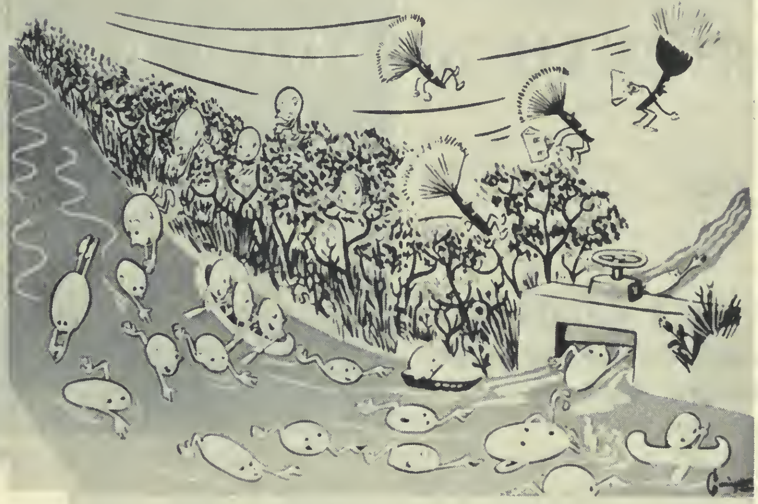
(3) BETTER OPERATION. It costs more money to operate a weedy ditchbank. Proper inspection of the system cannot be made to prevent serious damages and more labor is required to operate the system.

(4) ACCURATE MEASUREMENT. A weedy weir pool prevents accurate measurement of water. Are you getting your dollar's worth of water through your turnout?



DUCES YIELD

8. SEEDS SPREAD



the farm. It pays off by preventing reduction in yields, spread of weeds, harboring of insects, and preventing increases in production costs. You can't lose with a good ditchbank weed-control program. It benefits both the water user and his irrigation district.

7. HARBOR INSECTS

6. INCREASE COST

HOW LIME AFFECTS the GROWTH of YOUR PLANTS

FIGURE 1.

RICHARD B. WALKER, Ph. D.
Botany Department, University of Washington, Seattle, Washington

We wish to express our appreciation to Professor Vernon A. Mund, also of the University of Washington, who cooperated in making this article available for the *Era.*—Ed.

How does lime or calcium in the soil affect the growth of plants?

The answer to this question is not simple, since it involves consideration of the forms in which this element occurs in the soil, how the plant absorbs and uses it, and how calcium may affect the other elements which plants absorb and use in their growth.

Some soils contain calcium in the form of free limestone (calcium carbonate), which is sometimes in the surface layer but more often in the subsoil. Whether or not free limestone is present, all fertile soils contain large amounts, several tons per acre, of calcium in a form known as exchangeable calcium. The particles of clay and humus have the ability to hold tightly mineral elements on their surfaces, from which these minerals are removed only very slowly by the washing action of water but from which they may be readily absorbed by plant roots. In neutral or only slightly acid soils these exchangeable bases are mostly calcium, magnesium, and potassium; in acid soils there is present a large amount of hydrogen with a corresponding reduction in the calcium, magnesium, and potassium; while in alkali soils much sodium is present.

A particular soil is able to hold a certain *total* amount of these bases in the exchangeable form, and this amount is called the *base exchange capacity.* Soils which are high in clay and organic matter contents have higher base exchange capacities than the lighter more sandy soils. The exchangeable form of the various bases is of special interest because this is a form which is readily absorbed by plants.

BALANCE IS IMPORTANT

The total amount of the exchangeable bases which a soil contains is important, but often the *balance* or relative proportions of these bases is more vital. If the soil is very acid it has a large amount of exchangeable hydrogen and often a deficiency of the nutrient bases, calcium, magnesium, and potassium. If the soil has a large amount of exchangeable sodium, it is an alkali soil and is infertile, probably because the excess of sodium keeps the plant from absorbing enough calcium and magnesium. In a similar way, the amount of magnesium may be high enough in unusual soils that it prevents the plant from absorbing enough calcium, and occasionally potassium is high enough to disturb the normal absorption of magnesium. Only under rare conditions, to be described later, has calcium been found high enough to keep plants from getting the required amounts of potassium or magnesium. Calcium

is usually present in greater amount than the other bases in soils, and plants have apparently become adapted to this during ages of evolution. Often the amount of the various bases present is expressed in terms of the percentage of the base exchange capacity, and in these terms Dr. Firman Bear, of Rutgers University, has described the bases of an "ideal soil" as being 65 percent calcium, 10 percent magnesium, 5 percent potassium, and the other 20 percent mostly in hydrogen. Of course, fertile soils may vary considerably from these percentages, but the ideal values emphasize the requirements for a large proportion of calcium along with smaller but substantial amounts of magnesium and potassium.

ABSORPTION OF SOIL BASES BY PLANTS

Although a number of factors, such as light, temperature, water supply, and soil type, may have modifying effects, the amounts and proportions of the exchangeable bases have much influence on the growth and mineral composition of the crop plants. Generally speaking, the greater the total amount of soil bases, and especially the less acid or more saturated with bases the soil is, the greater will be the absorption of these bases by the plant. In a practical way, this means that if a soil is acid, we can add bases by liming or other fertilization, and thus improve the vegetable foods which furnish to animals and human beings the majority of their minerals. This ties in with the fact that often quality as well as quantity of plant products depends upon adequate mineral absorption.

Species of plants vary in their absorption of minerals even from the same soil, but often the total absorption of calcium, magnesium, potassium, and sodium (in some crops) will stay nearly constant for a particular kind of plant. If there is an excess of one element in the soil, the plant will absorb extra large amounts of this element, and the absorption of one or more of the other bases will drop. If this effect becomes extreme, the plant may become deficient in an element which is "crowded out."

If unbalance in the soil bases causes serious lack of balance in plant absorption, yields may be affected. This is illustrated in figure 1, in which the growth of Romaine lettuce was successively reduced as excess magnesium in the soil prevented the proper absorption of calcium by the plants. If the unbalance in uptake of calcium is not so severe, or is just starting, deficiency symptoms such as are pictured in figure 2 may be the warning. Although these examples show the production of calcium deficiency by the excess of magnesium, similar effects on plant calcium have been shown when sodium or potassium were too high in the soil. The overabundance of potassium may also lower magnesium absorption enough to reduce yields in some cases. In rare instances, calcium may be in excess, as exemplified by some high-lime soils in which the potassium supply would normally be adequate, but proves to be insufficient because the high calcium concentration depresses potassium absorption; this depression can be corrected by heavy potash fertilization. Perhaps more common are cases in which both calcium and potassium are high, causing a reduction of magnesium absorption to deficiency levels. Really a subject in itself is the fact that excessive natural lime or overliming may reduce the availability of phosphates or of micronutrients such as iron, zinc, manganese, and boron to levels that are insufficient for the best plant growth, especially in soils in which the humus contents are low.

SOIL AND TISSUE ANALYSES GIVE CHECKS ON NUTRIENT BALANCE

It is uneconomical for the grower to wait until poor growth, low yields, or deficiencies tell him that plants are not absorbing the essential minerals from his soil in balanced quantities. Heavy cropping, emphasis upon only nitrogen, phosphorus, and potassium in fertilizer programs,

FIGURE 2.

overliming, buildup of sodium from irrigation waters, leaching of light-textured soils by irrigation, or other factors may have reduced the yields on formerly productive land. Through county extension agents and other agricultural specialists, the farmer can usually arrange to have soil tests made which give much information on the balance of elements in the soil. Unfortunately, it is not always possible to predict from such soil analyses just how a particular crop will absorb minerals from the soil. Often soil tests can be followed up by testing or analysis of the plant leaves to find out what the plant has actually absorbed. Field kits are available to make tests for some nutrients, while other elements can only be determined in private or experiment station laboratories.

Care exercised in maintaining balance in the soil bases, and in insuring that the particular crops being grown are absorbing adequate and balanced amounts of the various elements (there is considerable information available in this connection for specific crops) will pay off in greater yields and higher quality of produce. # # #

Taliaferro Resigns to Accept New York State Power Authority Post

Commissioner W. A. Dexheimer announced that Henry B. Taliaferro, Chief of the Power Division since 1952, resigned effective December 21 to accept a key position with the New York State Power Authority which is developing the St. Lawrence Power Project.

Mr. Taliaferro, who transferred to Washington from Sacramento, Calif., where he had been Regional Power Manager in charge of production, distribution, and marketing power from the Central Valley Project, became Assistant Director of the Division in 1951.

Previously, he was employed by private and public agencies, including work with the Potomac Electric Power Co. in Washington, D. C., as Assistant to the Chief Engineer from 1931 to 1935. He served as Assistant Electrical Engineer for the District of Columbia during the period 1937–39.

Mr. Taliaferro is a graduate of the United States Naval Academy and saw active duty in the Tunisian, Sicilian, and Italian campaigns as commander of landing craft with a complement of 300 men and 30 officers. He was also in command of a LSM flotilla at Okinawa and Japan.

Disaster Averted

Continued from page 2

call in 1954 to avoid utter economic and agricultural disaster.

In a normal year, the Colorado-Big Thompson Project is expected to deliver some 250,000 acre-feet of supplemental irrigation water. In drouth year 1954 it delivered 300,352 acre-feet—about 120 percent of normal. Project water represented well over half of the year's total supply from all sources of 592,000 acre-feet, slightly less than the normal average of 595,000 acre-feet. This water reached an area of 400,000 of the 615,000 acres ultimately to be served. Day and night the Alva B. Adams tunnel flowed at top capacity to move the much-needed water to the East Slope. The results were inspiring.

The best proof of what might have been had not the Colorado-Big Thompson Project been able to meet the situation is obtained by comparing 1954 with 1934, the last serious drought year and the worst on record before 1954. Actually, in most respects, 1954 presented greater handicaps to crop production than did 1934. Therefore, estimates based upon a comparison of the 2 years provide conservative conclusions. But here, translated into tons and bushels, and sacks of farm produce, are the figures:

Additional yields per acre realized through use of Colorado-Big Thompson Project Water, 1954

Crop	Unit	With project water	Without project water [1]	Difference due to project water
Corn	Bushel	57	14	43
Wheat	do	25	21	4
Oats	do	35	32	3
Barley	do	32	28	4
Sugar beets	Ton	14.75	10.75	4
Potatoes	Sack	198	51	147
Beans	Bag	17	3.8	13.2
Alfalfa	Ton	3	1.4	1.6

[1] Based upon 1934 data.

Allowing for abandonment resulting from water shortages, where water was not available, the value of project water, based upon the above yield differential, is $22 million for the 1954 season. In recent years, gross crop production has averaged $46 million in the area served by the project in 1954. This year the total was $41 million. Without project water, the total would have plunged to $19 million. Thus, project water was worth $22 million directly to the farmers. In the 400,000 acre area receiving direct service, nearly every

farm used project water. Partial credit for saving crops on about 15 percent of the acreage may be attributed, however, to irrigation from wells.

Testimonials volunteered by merchants, bankers, and other businessmen from throughout the project area have revealed unanimous agreement that the project in 1954 was the keystone in the area's economic stability, despite the fact the adverse conditions recognized early in the crop year resulted in a general tightening of belts and momentary slacking in business activity. Later in the season, however, when the farmers saw that they were going to have a good crop, business was restored to normal levels and the overall year's business results were about normal.

Bankers report no cases of foreclosure or forced liquidation. Other indicators of financial distress, such as repossession of equipment, extensive refinancing or growing delinquencies in credit accounts, are not in evidence.

These benefits are not entirely limited to the service area alone. Their impact is felt throughout the State of Colorado and the Nation. The economic benefits of irrigation development have been said to spread outward across the nation like the circling ripples spread from a stone tossed into a quiet millpond. This has definitely been proven in the Colorado-Big Thompson service area during 1954.

The favorable economic effects of the high-stable level of farming activity in northern Colorado are felt by the eastern, midwestern and far western manufacturers of the farm machinery and equipment, fertilizers, foods, automobiles, clothing, furniture, appliances and other commodities purchased and used by the farmers throughout the Northern Colorado Conservancy District and by

their urban neighbors. The tax dollars paid by these same farmers and their urban neighbors have contributed materially to fulfillment of the missions of government, public education, health services, transportation and communications. It is estimated that Federal tax revenues, alone, arising out of the project area in fiscal year 1954 amounted to $41,763,000, with income taxes constituting the major share of that total—some $37,324,000.

Thus it was that the drought of 1954 in northern Colorado not only might have spelled disaster for the immediate area and its people, but it also could have touched adversely upon the well-being of persons in many walks of life throughout the entire State of Colorado and in far-distant sections of the Nation.

The 75-year-old dream which came true in 1954 thus proved the wisdom and the foresight of those early settlers who dared to dream such a grandiose dream and had the courage to work and struggle for its realization. # # #

HORSETOOTH RESERVOIR. ***Photo by Norton T. Novitt.***

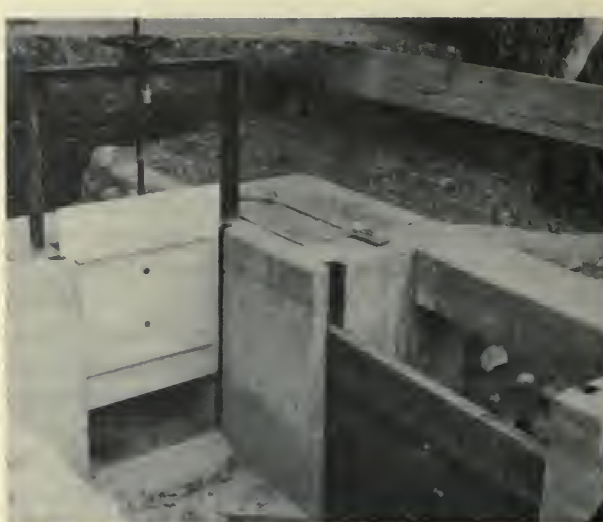
We want to take this opportunity to extend our appreciation to MR. MARTIN for his continued assistance and cooperation during his tour of duty with the Bureau.

We also extend to him congratulations and best wishes for success in his new position as Public Relations Manager for the Western Beet Sugar Producers.—Ed.

REHABILITATION AND BETTERMENT PAYS A DIVIDEND

by

R. J. McMULLIN, General Manager
SALT RIVER VALLEY WATER USERS' ASSOCIATION



Typical installation of rubber-sealed gate in combination check and turnout structure. Locked steel plate on top of structure covers a typical "check well".

Starting in 1950, the irrigation facilities of the Salt River Project in Central Arizona have been undergoing the biggest overhaul and improvement program since the Project was started in 1903.

With a backlog of deferred replacement and repair work which had accumulated because of labor and material shortages during and after World War II, the Salt River Valley Water Users' Association was faced with a job beyond its ability to finance from current operating funds.

Many miles of canals and laterals needed lining. Hundreds of deteriorated wood structures and several thousand obsolete wood gates needed replacing. Over 150 of the Project's 251 pumps required overhaul or conversion from 25- to 60-cycle operation. Dams needed repairs and a 40-year-old pumping plant boosting water to the Highline Canal required replacement.

Having experienced the spiral of rising labor costs after the war, and facing a future of increasing costs for maintenance and operations, the Water Users' Association was hard pressed to meet the challenge of the future. The ever-present need for water in an area where every drop is precious made conservation and modernization by lining the canals and laterals an urgent necessity.

An opportunity to work out a practical solution to these problems was presented when in 1949 the 81st Congress passed Public Law 335, which authorized the expenditure of interest-free funds for the rehabilitation and betterment of existing works of Federal Reclamation Projects. Under the provisions of this act, the Water Users' Association, assisted by the Bureau of Reclamation, developed a 6-year-rehabilitation program for the Salt River Project and made application for a $6,000,000 loan to cover the most urgently required construction. This amount represented the first phase of an estimated $30,000,000 program to bring the irrigation facilities up to modern standards.

During the planning stages, the Association and Bureau engineers worked out a general program allocating the $6,000,000 to the items requiring most immediate attention.

With 140 miles of canals, 827 miles of laterals, and 307 miles of pump and tail-water collection ditches in the transmission and distribution system of the 242,000-acre project, a careful approach had to be taken to get maximum returns in operating efficiency and water conservation with available funds.

Water-loss records and past seepage-test results were accumulated and studied. New seepage tests were made using the permeameter developed by the Bureau to determine the reaches of canals and laterals that should be lined first to accomplish the greatest water savings.

Starting in April 1950, when the first annual

New concrete check structure with commercial type radial gates.

Completed section of lateral 23 after placement of pneumatically applied mortar lining.

allotment of $790,000 was made available by the Bureau of Reclamation, the initial program was 75 percent complete by October 31, 1954, at which time $4,518,000 had been expended on improvements.

Lateral lining, pipelines and structures have received the most attention, with $2,175,000, or 48 percent of the program funds being expended to date for these items. A total of 45 miles of laterals have been lined, about 28 miles with pneumatically applied mortar, and 17 miles with unreinforced concrete installed by the slipform method. The average cost for lining laterals has been about $20,000 per mile, including all costs for filling existing ditches, excavating and shaping new sections, all preparatory work, such as the removal of trees and other obstructions.

Suburban areas within the Project boundaries rapidly grew and created a pressing demand to cover ditches which create a hazard in populated areas and interfere with road widening plans. This demand was met by initiating a program of replacing open ditches with concrete pipelines on a participating basis with adjoining property owners, city, State, and county highway agencies. With this arrangement, the participants supply the pipe for installation by the Association. Most of the pipeline installations have been on this basis, and the Association has installed a total of 28.22 miles of concrete pipelines at an average cost of only $23,100 per mile.

An important feature of the lateral improvement program has been the installation of rubber-sealed metal gates in all of the turnout structures. These gates were developed by Association engineers and have replaced 4,468 obsolete wood gates which required excessive maintenance. In addition to the operation and maintenance benefits, the gate-replacement program has been effective in the elimination of leakage at structures which was a source of considerable water loss for the project and an inconvenience to the user because of the increased weed growth in farm service ditches.

The new headgate installations include a 1⅞-inch slotted rubber seal on each side of the structure opening in which the metal gate is inserted. The extruded rubber strip is held in place by mastic cement and a redwood wedge. A rubber seat at the bottom of the opening makes a complete seal when the gate is closed. The gate is made of ⅛- or $\frac{3}{16}$-inch steel plate, depending on size, which is braced with strips of angle iron. The gate is sand blasted and sprayed with a zinc metal coating, in the project shop, to prevent corrosion. The unit is installed with a metal frame or mantel to support a screw stem and lifting wheel, permitting an accurate gate adjustment for the water deliveries.

The entire gate-replacement program has cost $126,000, for an average of $28.50 per unit. The overall benefits in water savings, reduced maintenance, and improved water control has already repaid the investment. Other lateral facilities installed during the program to date include 484 weirs, 149 check wells, 87 rubble drops, 33 culverts, and 730 turnout structures.

The second largest portion of the program to date has been the rehabilitation of the Project

ARIZONA CANAL prior to lining.

SAME VIEW after lining.

wells and pumping equipment. With an expenditure of $1,206,000, the Association has reconditioned 151 wells and pumps, of which 75 were converted from 25- to 60-cycle operation, and redrilled 15 wells to an average depth of 1,000 feet.

Included in this phase of the program was the construction of the new Highline pumping plant at a cost of $202,000. This unit consists of 8 individual turbine-type booster pumps totaling 1,325 horsepower, capable of lifting 56,000 g. p. m. 42 feet to the Highline Canal.

Designed by a team of Bureau of Reclamation and Association Engineers working together, this plant is modern in every detail. Pushbutton, motor-operated control valves, instantaneous totalizing meters, and automatic trash racks, in addition to the most efficient pumping equipment available, have produced a $25,000 savings in labor and power during the first year of operation.

The lining of 7⅛ miles of main canal and the replacement of 37 canal structures have required an expenditure of $572,000 to date. The canal lining includes both banks and bottom in some reaches and one or two banks only at other locations for erosion control.

Much needed repairs were also completed on the storage dams. Concrete slab additions to the left thrust block of Stewart Mountain Dam were constructed. Also, the grouting of horizontal construction joints in several sections of the dam and spillway wall were completed at a total cost of $148,000. Emergency repairs to the outlet works and inlet tower at Roosevelt Dam cost $53,500, and improved the operation of this keystone structure of the water-storage system.

What are the benefits of such a program, and how does the contract work out with the Bureau of Reclamation? These are the questions most often asked by shareholders and project visitors.

The answer to the first question is revealed in the water-delivery records of the Association. These records show a decrease of 4 percent in water losses from 1950 to the end of 1953. In running approximately 1 million acre-feet per year in the system, this represents an annual water savings of 40,000 acre-feet. Valued at $5 per acre-foot, or $200,000 per year, the savings amount to a substantial annual return on all funds expended on lining and structures to date.

In productive but water-starved Arizona, where an acre-foot of water will produce an average of $60 in crop value, water savings of this magnitude take on real significance.

An added justification and gratifying result of the program is the reduction in maintenance costs. The records show that the Association expended $497,000 for maintenance of canals and laterals in 1949. Taking the actual costs for 1954 through October, and making generous estimates for November and December, the 1954 cost was approximately $485,000.

This amounts to a reduction of 2½ percent, but the real savings become apparent when compared with the average wage of hourly field and shop employees of the Association which has increased 36.3 percent during this same period. Other benefits have been improved operations and better service for the 7,000 farm users and 28,000 active subdivision accounts in the project.

The contracts with the Bureau of Reclamation

provide for advancement of funds to the Association on a quarterly basis, and a separate contract is signed for each fiscal year program.

Provisions in the contract allow Association forces to do the engineering and construction work subject to approval and inspection by the Bureau. This is a very satisfactory arrangement, as all work must be closely coordinated with irrigation operations, which are continuous throughout the year. Relations with the Bureau have been completely harmonious in all aspects of the program.

In summary, many changes have occurred in the irrigation system of the Salt River Project since April 1950. The Water Users Association is convinced that rehabilitation and betterment pays off.

What of the future? Plans are being completed to make application for an extension of the program to continue the work of bringing the Project up to modern standards. # # #

ELECTRIFYING THE SOIL

Continued from page 10

amount of research that this activity will justify may be extensive. Both high and low potentials have been used in this work with some promising results.

Sources and Types of Current Used

The electric current used in most of these experiments is of the direct current type. The potential and current have been varied as has the frequency. The current has been secured from such sources as electric welders, rectifiers and impulse generators. In the system used for reclaiming land it would appear that the wind-driven generator might have a place. No storage battery would be required as intermittent treatment would probably be satisfactory. A portable surge generator of 40,000 volts is shown in figure 9.

Conclusion

Although the tests have not been carried through far enough to secure many conclusive results, the work seems to open up a new realm of agricultural research. The usual comment of those who have inspected the work in the field is, "There is evidently something to it." A prominent research man in one of our western agricultural colleges, after reviewing some of the work, remarked that it was the only new approach made within the last 50 years toward the reclaiming of agricultural land. ###

Robert W. Jennings New Regional Director at Amarillo, Texas

Robert W. Jennings, formerly Alaskan District Manager for the Bureau of Reclamation, was named Regional Director for Region 5 with headquarters at Amarillo, Tex., by Secretary of the Interior Douglas McKay. He took over his new post on December 1.

Jennings, who was appointed by Commissioner of Reclamation W. A. Dexheimer, succeeds the late H. E. Robbins, who died September 12.

The new regional director has been with the Bureau of Reclamation since he graduated from the Utah State Agricultural College with a B. S. in civil engineering in 1933, with the exception of a year and a half with the Geological Survey. He is a native of Logan, Utah.

Prior to his appointment as Alaskan District Manager in August 1953, he was area engineer at Grand Junction, Colo. #

SPOTLIGHT ON *Sedimentation*

SILT DEPOSIT in Arrowrock Reservoir, Boise Project, Idaho, when reservoir was emptied to permit inspection of sluice gates. ***Photo by Stan Rasmussen.***

by ROLAND W. FIFE, Area Hydrologist, Area Development Office, Albuquerque, N. Mex.

A procedure for predicting the location of future sediment deposits in reservoirs that will save time and money has been developed by Mr. E. A. Cristofano, Hydraulic Engineer of the Area Development Office at Albuquerque, N. Mex.

One of the most important factors to be considered in today's complex design of a potential reservoir is the deposition and accumulation of sediment. The effects of reservoir sedimentation are felt in many ways—through the direct loss of water-storage capacity in the reservoir itself, increased evaporation losses in the reservoir pool, increased transpiration losses in delta areas, and the effect on the general economy of the region which is dependent upon the reservoir.

The sediment accumulation in a reservoir can be influenced by measures to lessen or abate soil erosion within the drainage basin above the reservoir. It is obvious that the lesser degree of soil erosion above the reservoir, brought about through conservation practices, would decrease the sediment load into the reservoir. This is a factor of influence that must be considered in the economic design of a potential reservoir.

In planning reservoirs, storage capacity should be allocated for accumulation of sediment deposits. Previously it has been common practice to allocate capacity for sediment accumulation in a so-called dead-storage pool in the deepest part of the reservoir. This dead-storage pool has been

allocated on a basis of reservoir elevation; that is, all the storage capacity below a certain reservoir stage being reserved for sediment accumulation. However, allocation for sediment storage on the basis of pool elevation has not proven to be an entirely satisfactory procedure. Sediment deposits will rarely be confined to the dead-storage pool as the heavier material will begin to be dropped as soon as it enters the backwater area, with finer material deposits being located further downstream. This results in deposits occuring throughout the length of the reservoir, a considerable portion of which will be outside the dead-storage pool, and will occur in the irrigation, power, or flood-control pools or even in the delta area. Under such a method of allocation, the capacities reserved for irrigation, power, and flood control will be encroached upon by sediment accumulations. For proper planning, therefore, allocations for sediment accumulation, irrigation, power, flood control, or other purposes, should be made on the basis of storage capacities rather than elevations. Consequently, it is important in planning a potential reservoir to estimate the probable location of reservoir sediment deposits.

Predicting the location of sediment deposits that will occur in reservoirs in the future has long been an involved and tiresome task. The method generally used heretofore consists of making an initial adjustment for sediment deposits in the original reservoir capacity at different elevations. This is done in accordance with a design curve which relates percent depth to percent sediment accumulated, which is based on the average of several reservoir resurveys. A new curve is computed and is then readjusted by the trial and error method of balancing the elevation-capacity-area relationship until an acceptable curve is obtained. In effect, this method fits the area to the capacity.

The procedure developed by Mr. Cristofano, known as the Area Incurement Method, fits the capacity to the area. Knowing from experience that the new curve will approximately parallel the original, Mr. Cristofano has derived a method to distribute the estimated sediment accumulation by area adjustments in such a manner that the number of trials required to fit the capacity to the area, in the final readjustment, is minimized. By this method, he has found the estimated distribution of sediment to be as accurate as by the method formerly used and can be accomplished in approximately one-fifth of the time. The procedure has been outlined clearly by consecutive steps and is simple enough that personnel unfamiliar with sediment work can follow it to its logical conclusion.

Hydraulic Engineer Eugene A. Cristofano (right) receives superior accomplishment award from Area Development Engineer John L. Mutz for time-saving procedure. ***Photo by C. E. Redman, Albuquerque, N. Mex.***

Capacities, after sediment deposition as determined by the resurvey data of several existing reservoirs, were compared with the results obtained by the use of the Area Increment Method, and a good correlation was found to exist between the resurvey capacities and computed capacities. The Area Increment Method is considered a satisfactory analysis of sediment deposition in the design of a potential reservoir and it has been used in Region 5.

In recognition of the valuable contribution to the technical field of sedimentation, and because of the savings that will result through use of the method in future studies, Mr. Cristofano has been given the Interior Department's Superior Accomplishment Award. # # #

YOUR MAGAZINE

Are there particular types of articles which you would like to see in the ERA that we have not printed to date? If so, please let us know, and we shall do our best to comply with your wishes.

LETTERS

Comments From Canada

DEAR SIRS: Sometime ago I read Mr. Maurice Langley's fine article, "They Plant and Harvest the Year Around," in *The Reclamation Era*, May 1954, and was pleased to see his picture of a load of seed of C. T. 186 being examined by Mr. A. B. Masson. This wheat, as you know, has since been named Selkirk.

We are anxious to obtain one or more good pictures of a field of Selkirk wheat as grown in California or Arizona in 1953–54, preferably one showing Mr. Masson. Our director of Experimental Farm Service in Canada would like to use it in his annual report.

Yours sincerely,

[s] R. F. PETERSON,
Officer in Charge, Cereal Breeding Laboratory, P. O. Box 322, University of Manitoba, Winnipeg, Manitoba, Canada.

It Gets Around

DEAR MR. MCCARTHY: Just happened to see the August issue of *The Reclamation Era* and found it to be an excellent publication.

On page 63, under "Get Acquainted Copies," it states that copies of back issues are available. Having enjoyed reading the August issue, I would appreciate it if you would send me some back issues as they are available.

Mahalo nui loa (thank you very much).

Very truly yours,

[s] ELLWOOD LEWIS BARTZ,
Civil and Hydraulic Engineer, 534 Mapu Lane, Honolulu 17, Hawaii.

IRRIGATION INTEREST

DEAR SIRS: On page 94 in your November issue of *The Reclamation Era*, is a picture which I would like to use. If it is available, would you please send me a glossy print of it?

The cut line below it reads "Ralston Chute, Shoshone project, Wyo. Photo by Chas. A. Knell."

I would also like to have your permission to quote some of the irrigation data included in this issue.

Sincerely,

[S] RALPH C. HUGHES,
Deere & Co., Moline, Ill.

DO YOU KNOW . .

- The Tule Lake Bird Reserve is a favored resting place for ducks and geese on the Pacific flyway?
- In the State of Nebraska, one of the 17 Reclamation States, there are more miles of river than in any other State in the United States—3,500?
- During the peak of the Republican River flood in 1935 the flow of water at Cambridge, Nebr. (10 billion gallons) was enough to fill Lake Mead within a 60-day period?
- The South Ogden Conservation District of the Ogden River project in Utah is the only high-pressure irrigation system constructed by the Bureau of Reclamation in the intermountain States enabling irrigators to obtain their water upon demand rather than "waiting their turn"?

MORE POWER FOR SALT RIVER

Victor I. Corbell, president of the Salt River Project in Arizona, recently announced plans for building a new 100,000-kilowatt steam plant, costing about $13 million.

Mr. Corbell said that the steady growth of metropolitan Phoenix and the area served by the Salt River Power District resulted in increased demands for more electricity and prompted the plans for the new plant. Comparison between 1950 figures and the estimated totals for 1954 thoroughly reflect the need for additional power. An average of 5,000 power customers have been added each year since 1950. By the end of 1954, the Power District will be supplying power to 40,000 customers. The total sales of electricity during the same period increased almost 25 percent, or from 780 million to about 1 billion kilowatt-hours.

Construction of the new plant is expected to start in August 1955, with completion set for the spring of 1957.

The new steam plant can be compared in many ways with the 100,000-kilowatt Kyrene steam power plant near Tempe, Ariz., which the Power District recently placed in operation.

Still to be decided is the location of the plant. This will be determined as a result of an extensive engineering study now in progress.

The Salt River Project shareholders planned to vote an $11 million bond issue to finance the plant. The $2 million additional would be supplied out of current power revenues. #

"SETTLEMENT OPPORTUNITIES" Available

The 1955 edition of the pamphlet entitled "Settlement Opportunities on Reclamation Projects" is now available for public distribution.

The pamphlet is designed to give information to veterans and others who would homestead on irrigated public land; purchase private land acquired by the Government on reclamation projects and offered for sale; are interested in privately owned lands offered for sale by individual owners.

Copies of the pamphlet may be obtained by writing to your nearest Regional Director, or the Commissioner, Bureau of Reclamation, Washington 25, D. C. See back cover of the *Era* for list of Regional Directors and their addresses. •

The Editor's Column

The following facts have been gleaned from the United States Department of Agriculture's Statistical Summary dated November 19. We hope that you find them helpful.

Cotton Prospects Increased During October

Exceptionally favorable October weather in most areas developed late bolls and facilitated harvesting with a minimum of field losses. Better yields than expected resulted in an increase of 695,000 bales, or 5.6 percent, in prospective production, compared with a month earlier. A 1954 cotton crop of 13,206,000 bales is forecast as of November 1—compared with 16,465,000 bales in 1953 and the 10-year average of 12,448,000 bales.

Hay and Forage Supplies Adequate

Hay and forage supplies are generally adequate for winter needs in North Atlantic, North Central, and Pacific States. Drought in South Atlantic and South Central States reduced forage growth even below last year's short supply. Western States also report slightly less roughage than last year.

Pastures are good to excellent in most Northern States and in Pacific coast areas. Critical pasture shortage exists in Southern States from the Atlantic coast to the Rockies. Central and southern Rocky Mountain areas also have short supplies of feed on winter ranges.

Other Crops—November 1 Estimates

Sugar beets—13.8 million tons—14 percent above 1953; 40 percent above average. Digging near completion November 1.

Potatoes—347 million bushels—7 percent below 1953; 15 percent below average. Harvest practically completed by November 1 except in a few scattered areas, despite delaying rains.

Beans, dry edible—18.4 million bags—down slightly from October 1 forecast, but 1.3 percent above 1953 production.

Fruits and Nuts

Deciduous fruit production in 1954 will be about 2 percent larger than in 1953, although 6 percent below average. Larger crops of apples, pears, grapes, and prunes have been produced than last year, but smaller crops of peaches, cherries, plums, and apricots.

Of the *citrus fruits*, oranges for the 1954–55 season are expected to exceed last season's crop, but grapefruit volume will be slightly smaller. Lemon harvests are expected to be 12 percent less than last season, but above average.

Production of *tree nuts* is expected to be 14 percent less than last year. Increases in almonds, walnuts, and filberts are more than offset by the much smaller pecan crop.

Reclamation Gets Pozzolan Research Grant

The Bureau of Reclamation recently received a grant of $10,000 from the National Science Foundation for the support of research on "Hydration of Portland Pozzolan Cement" to be conducted in the Bureau's Denver Engineering Center. Richard C. Mielenz will be the principal investigator.

Dr. Mielenz, who has a broad educational and professional background in geology, is head of the Center's Petrographic Laboratory. Dr. N. Cyril Schieltz, X-ray crystallographer at the laboratory, has been designated alternate researcher.

The research is designed to reveal new information on the fundamental chemical and physical reactions involved in the setting of cement in the presence of pozzolans. Pozzolans, either natural or artificial, are materials with certain beneficial properties, widely used to supplement manufactured cement where large quantities are used. Their use in large reclamation dams has resulted in savings of millions of dollars. A pozzolanic material, fly ash, was used in the construction of Reclamation's Hungry Horse Dam in Montana, saving an estimated $6,000,000.

Pozzolans get their name from the natural materials obtained near Pozzuoli, Italy, which has been used since the time of the ancient Romans. One such material is a volcanic ash from Mount Vesuvius. Other pozzolans are volcanic tuffs, pumice, and diatomaceous earth. Artificial pozzolans include fly ash, granulated blast furnace slag, and burnt clay or shale.

Pozzolans are also effective in preventing the deterioration of concrete in the presence of alkalis. Although a considerable fund of experience has been accumulated in the practical uses of pozzolan-cement concrete, very little is actually known about the fundamental chemical and physical reactions involved. #

RECENT MAJOR CONTRACT AWARDS

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DC-4187	Missouri River Basin, Nebr.	Oct. 12	Construction of earthwork and structures for Franklin Canal, Station 1454 + 00 to 2178 + 20, and drains.	List and Clark Construction Co., Kansas City, Mo.	$971,459
DS-4211	Missouri River Basin, N. Dak.	Oct. 1	Three 20,000/26,667/33,333-kilovolt-ampere autotransformers for Fargo substation.	American Elin Corp., New York, N. Y.	278,680
DC-4223	Middle Rio Grande, N. Mex.	Nov. 2	Construction of 4.5 miles of closed drains for Unit AE-2 rehabilitation and drainage.	E. M. Silver, Albuquerque, N. Mex.	124,457
DS-4233	Minidoka, Idaho	Nov. 5	Five horizontal, centrifugal-type pumping units for Unit A pumping plant.	Economy Pumps, Inc., Division of C. H. Wheeler Manufacturing Co., Philadelphia, Pa.	119,611
DC-4240	Missouri River Basin, S. Dak.	Nov. 9	Construction of additions and modifications for Watertown substation for 230 kilovolt operation.	Electrical Engineering and Construction Service, Inc., Denver, Colo.	102,870
DC-4246	Columbia Basin, Wash	Oct. 26	Construction of earthwork and structures lateral W20, Station 1 + 24.94 Ah. to 85 + 50, Naylor siphon, West Canal laterals (Block 89), utilizing monolithic concrete in siphon.	Henly Construction Co., Yakima, Wash.	580,327
DC-4247	Missouri River Basin, Nebr.	Nov. 3	Construction of Milburn diversion dam and Sargent Canal, Station 12 + 30 to 38 + 80 Bk.	Platte Valley Construction Co., Grand Island, Nebr.	279,096
DC-4252	Columbia Basin, Wash	Nov. 3	Construction of Mesa pumping plant and canal lateral PE38.9B, Station 0 + 50 to 23 + 50 (Block 14).	Buchanan-Sather and De-Rycke, Seattle, Wash.	167,778
DC-4253	Missouri River Basin, Kans.	Nov. 22	Construction of Lovewell Dam	Cook Construction Co., Jackson, Miss.	2,324,850
DC-4255	Missouri River Basin, Wyo.	Nov. 27	Construction of Glendo Dam, powerplant foundation, and roads.	C. F. Lytle Co. and Green Construction Co., Sioux City, Iowa.	6,270,790
DC-4256	Central Valley, Calif	Nov. 2	Construction of earthwork and structures for Corning Canal, Station 39 + 50 to 361 + 75.	Somers and Stacy, Klamath Falls, Oreg.	632,698
DC-4258	Gila, Ariz	Nov. 18	Construction of earthwork, concrete lateral lining, and structures for Unit 2, Dome and Wellton-Mohawk distribution system.	Morrison-Knudsen Co., Inc., Los Angeles, Calif.	816,744
DC-4259	Missouri River Basin, Nebr.	Dec. 1	Construction of earthwork and structures for Sargent Canal, Station 27 + 10.93 Ah. to 595 + 00, wasteways and drains.	Diamond Engineering Co., Grand Island, Nebr.	414,712
DC-4263	Columbia Basin, Wash	Dec. 14	Construction of earthwork and structures for lateral W20, Station 85 + 50 to 428 + 50, west canal laterals, Block 89.	George W. Lewis, Kennewick, Wash.	427,335
DC-4267	Central Valley, Calif	Nov. 30	Construction of earthwork and structures for lateral 24.2, Station 981 + 43.25 to 1114 + 72.05, Unit 3, Madera distribution system.	Hubbs Equipment Co., Colton, Calif.	121,608
DC-4269	Missouri River Basin, N. Dak.	Dec. 3	Stringing conductors and overhead ground wires for 83 miles of Jamestown-Fargo 230-kilovolt transmission line.	Hallett Construction Co., Crosby, Minn.	720,429
DC-4273	Gila, Ariz	Dec. 13	Construction of earthwork, concrete lateral lining, and structures for Unit 4 of Mohawk distribution system.	Morrison-Knudsen Co., Inc., Los Angeles, Calif.	634,476
117C-261	Columbia Basin, Wash	Oct. 6	Construction of earth and blended lining for Eltopia branch canal between Station 236 + 00 and 555 + 00.	George W. Lewis, Kennewick, Wash.	127,480
703C-354	North Platte, Wyo.-Nebr.	Nov. 1	Construction of earthwork, buried asphaltic membrane lining, and structures for Fort Laramie Canal, Station 2070 + 00 to 2128 + 00 and 2925 + 00 to 2996 + 29.	Lichty Construction Co., Casper, Wyo.	132,642

WORK CURRENTLY SCHEDULED THROUGH FEBRUARY 1955*

Project	Description of work or material
Carlsbad, N. Mex.	Constructing an emergency spillway on the left abutment of Alamogordo Dam, raising the existing earth dam, and modifying the existing concrete service spillway structure. Near Fort Sumner.
Central valley, Calif.	Constructing 4.7 miles of 372 c. f. s. capacity Corning Canal, second section. Near Red Bluff.
Do	Furnishing and erecting a 28- by 40-foot office building, 20- by 100-foot and 32- by 100-foot car shelters, and a 16- by 20-foot paint building, all prefabricated metal; erecting a Government-furnished 50- by 80-foot prefabricated metal warehouse building; installing sewage, water, and electrical services; placing bituminous and gravel surfacing and furnishing and erecting chain link fence. At Orange Cove.
Do	Constructing fish hatchery buildings, holding ponds, and facilities. Near Nimbus Dam.
Colorado-Big Thompson, Colo.	Construction 1.3 miles of 125 c. f. s. capacity South Platte supply canal, South Platte section, including structures and about 4,000 feet of 18-inch thick blended earth lining. About four miles northwest of Fort Lupton.
Columbia Basin, Wash.	Constructing Lateral W-20 (Station 428+50 to Station 792+00), will consist of 12 turnouts, 2 bridges, 1 check, drop and wasteway; 3.4 miles of earth-lined canal varying in bottom width from 32 to 22 feet; 3.5 miles of membrane-lined canal varying in bottom width from 20 to 12 feet. Near Ephrata.
Do	Constructing 18.4 miles of canals and laterals varying in bottom width from 10 to 2 feet, and appurtenant structures, and installing 3 pumping plants of 3, 9, and 24 c. f. s. capacities. Near Mesa.
Do	Constructing 40 miles of unlined laterals and sublaterals varying in bottom widths from 10 to 2 feet; 9.7 miles of concrete-lined laterals varying in bottom widths from 5 to 2 feet; 7.2 miles of 54- to 12-inch concrete pipe and appurtenant structures, installing 4 pumping plants of 4 to 10 c. f. s. capacities. West of Mesa.
Columbia Basin, Wash.	Constructing 28 miles of lined laterals with bottom widths of 5 and 3 feet, 4 miles of 48- to 15-inch pipelines, and 12 miles of wasteway with bottom widths of 2 to 6 feet and constructing 2 pumping plants with discharge lines, for Lateral Block 89, east part, W18-A, about 7 miles south of Ephrata.
Do	Furnishing and placing 3-inch gravel surfacing on about 60 miles of O & M operating roads. Near Warden and Othello.
Do	Furnishing and placing gravel surfacing on about 27 miles of O & M operating roads. North of Pasco.
Do	Constructing a three-inch gravel blanket in about 5 miles of laterals in Block 42, about 7 miles south of Moses Lake.
Do	One 26- by 78-foot steel frame building 26 feet high, with metal siding, metal decking, and 6-ton crane runway for Mesa pumping plant. Estimated weight of structural steel: 55,000 pounds.
Davis, Dam, Ariz.	Constructing 69-kilovolt additions and modifications to the 161/34.5/4.0-kilovolt-ampere Gila Substation will include constructing foundations, furnishing and erecting new steel structures, removing or modifying existing steel structures, and installing electrical equipment, major items of which will be Government-furnished. Near Yuma.
Gila, Ariz	Constructing 16 miles of 80 to 15 c. f. s. capacity canal and laterals, including 2 pumping plants of 105 and 80 c. f. s. capacities, and 1 relift pumping plant of 15 c. f. s. capacity, checks, drops, siphons, pipelines, steel pipe canal crossings, and turnout structures, for Ralph's Mill distribution system, 30 miles east of Yuma.
Do	Constructing 20 miles of 125 to 15 c. f. s. capacity concrete-lined canal and laterals, including 2 relift pumping plants of 125 and 70 c. f. s. capacities, checks, siphons, and turnout structures and constructing 9 miles of floodway dikes and channels including floodway drop structure, for Texas Hill distribution system, 50 miles east of Yuma.

*Subject to change.

WORK CURRENTLY SCHEDULED—Continued

Project	Description of work or material
Minidoka, Idaho	Construction of a reinforced-concrete substructure and structural steel superstructure with metal siding and roof deck to house three 60 c. f. s. pumps, one 40 c. f. s. pump, one 20 c. f. s. pump, and necessary electrical control cubicles; installation of the pumps and three 1,500 hp. motors, one 1,000-hp. motor, and one 500-hp. motor. Construction of a 78-inch discharge pipeline about 1,450 feet long with a surge tank and an outlet structure at end of discharge line will also be included. Near Rupert.
Do	Constructing the 138/34.5-kilovolt Heyburn Substation will include grading and fencing the site, constructing foundations and a small service building, furnishing and erecting steel structures, and installing electrical equipment, major items of which will be Government-furnished. Near Heyburn.
Missouri River Basin, Kans.	Constructing about 2 miles of 685 c. f. s. capacity Courtland Canal, and about 1 mile of lateral, including siphon, culverts, turnouts, checks, drain inlets and orifice structure, and inlet conduit to Lovewell Reservoir. Near Lovewell, Kans.
Missouri River Basin, Mont.	Two vertical-shaft hydraulic turbine-driven centrifugal-type pumping units each with a capacity of 150 c. f. s. at a total head of 163 feet (design head on turbine 120 feet) for Helena Valley pumping plant.
Missouri River Basin, Nebr.	Constructing a 34.5-kilovolt bay addition to the existing substation will consist of constructing foundations and installing Government-furnished structural steel and electrical equipment, including 1 circuit breaker, 1 bypass switch, 6 hook switches, 1 potential transformer, and 2 current transformers. Near Alliance.
Missouri River Basin, N. Dak.	Constructing the 230/115/69/12.5-kilovolt Fargo Substation will include constructing foundations and a concrete block service and control building, furnishing and erecting steel structures, and installing electrical equipment, major items of which will be Government-furnished.
Missouri River Basin, N. Dak.-S. Dak.	Constructing about 85 miles of 115-kilovolt, wood-pole, H-frame, transmission line extending from Edgeley Substation to Groton Substation. All materials to be furnished by the contractor. From near Edgeley, N. Dak., to near Groton, S. Dak.
Missouri River Basin, S. Dak.	Stringing conductors and overhead ground wire for 1 circuit on existing double-circuit steel towers for about 130 miles of 230-kilovolt steel tower transmission line extending from a tap on the Fort Randall-Oahe transmission line past the Huron Substation to the Watertown Substation. All materials to be furnished by contractor. From south and east of Pierre to Huron and Watertown.
Do	Constructing about 8.3 miles of 115-kilovolt, wood-pole, H-frame, transmission line extending from a tap on the Fort Randall-Sioux Falls 115-kilovolt transmission line to the Gavins Point switchyard. All materials to be furnished by the contractor. Near Yankton.
Do	Constructing the 115/34.5/7.2/4.15-kilovolt Pierre Substation, near Pierre. Work will include grading and fencing the site, constructing foundations and a small service building, furnishing and erecting steel structures, and installing electrical equipment, major items of which will be Government-furnished.
Missouri River Basin, S. Dak.-Nebr.	Constructing about 32.5 miles of 115-kilovolt, wood-pole, H-frame, transmission line extending from Gavins Point Substation to Belden Substation. All materials except insulators to be furnished by the contractor. From near Yankton, S. Dak., to near Belden, Nebr.
Missouri River Basin, Wyo.	Constructing 7,870 feet of discharge lines involving 48-, 24-, and 21-inch HC pipe; 4,800 feet of laterals with a bottom width of 10 to 3 feet; and 17, 15.2, 12.2, 15.8, and 15 c. f. s. outdoor pumping plants and one 98 c. f. s. indoor pumping plant with metal superstructure for the Hanover-Bluff Unit. Near Worland.
Do	Constructing 34.5-kilovolt additions to the 115/69/12.47-kilovolt Lovell Substation will include constructing foundations, furnishing and erecting steel structures, and installing electrical equipment, major items of which will be Government-furnished. Near Lovell.
Do	Furnishing materials and constructing 5 permanent-type residences, two 7-car garages, park area for 20 trailers, sewage disposal and water distribution systems, and gravel-surfaced streets at Glendo.
Do	Two motor-driven, horizontal, centrifugal-type, pumping units each with a capacity of 42 c. f. s. at a total head of 109 feet for Hanover Pumping Plant No. 2.
Missouri River Basin, Wyo.-Nebr.	Constructing about 204 miles of 115-kilovolt, wood-pole, H-frame, transmission line extending from Alcova switchyard near Casper, to Casper Substation, at Casper, and from Casper Substation to Gering Substation. Materials to be jointly furnished by Government and contractor. From near Casper, Wyo., to near Gering, Nebr.
Palisades, Idaho	Grading and structure for 4.2 miles of Wyoming State Highway (U. S. Nos. 26 and 89). Near Alpine.
Do	Clearing second portion of the Palisades Reservoir area along the Snake River in Idaho and Wyoming about 70 miles southeast of Idaho Falls, Idaho.
Riverton, Wyo	Constructing open and closed drains on Third Division.
Shoshone, Wyo	Constructing 0.25 mile of open and from 3.75 to 4.75 miles of closed drains from 8 to 12 miles southwest of Powell. Government to furnish tile.
Weber Basin, Utah.	One 9-foot 4-inch by 9-foot 6-inch radial gate for tunnel intake and one 10-foot by 12-foot 6-inch radial gate for sluiceway, for Gateway Canal.
Yakima, Wash	Raising existing concrete Prosser diversion dam, enlarging the headworks, constructing fishways and enlarging fish screens, building log boom, and enlarging about 2.4 miles of Chandler Canal from 1,100 to 1,500 c. f. s. Near Prosser.
Do	Constructing 400 feet of main canal varying in bottom width from 14 to 8 feet, and appurtenant structures including 1,400 feet of 78-inch and 575 feet of 54-inch siphon spillway, wasteway, culverts under the railroad and highway, and access and service roads; constructing the 20 cfs capacity Amon pumping plant, wasteway and box culvert; constructing 1,600 feet of feeder canal with bottom width of 10 feet. Hydraulic turbines and pumps are to be Government-furnished, all other equipment is to be furnished and installed by contractor. Near Vista.
Do	Installing nonembedded parts of two 8,500-hp. turbines and two 167 c. f. s. turbine-driven pumps, miscellaneous metalwork and electrical equipment in and on the Chandler power and pumping plant; constructing switchyard, including furnishing and erecting structural steel, installing electrical equipment and piping systems; and completing all other work, including architectural finish, and heating and ventilating for full operation of the plant. Near Chandler.

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The Reclamation Era

May 1955

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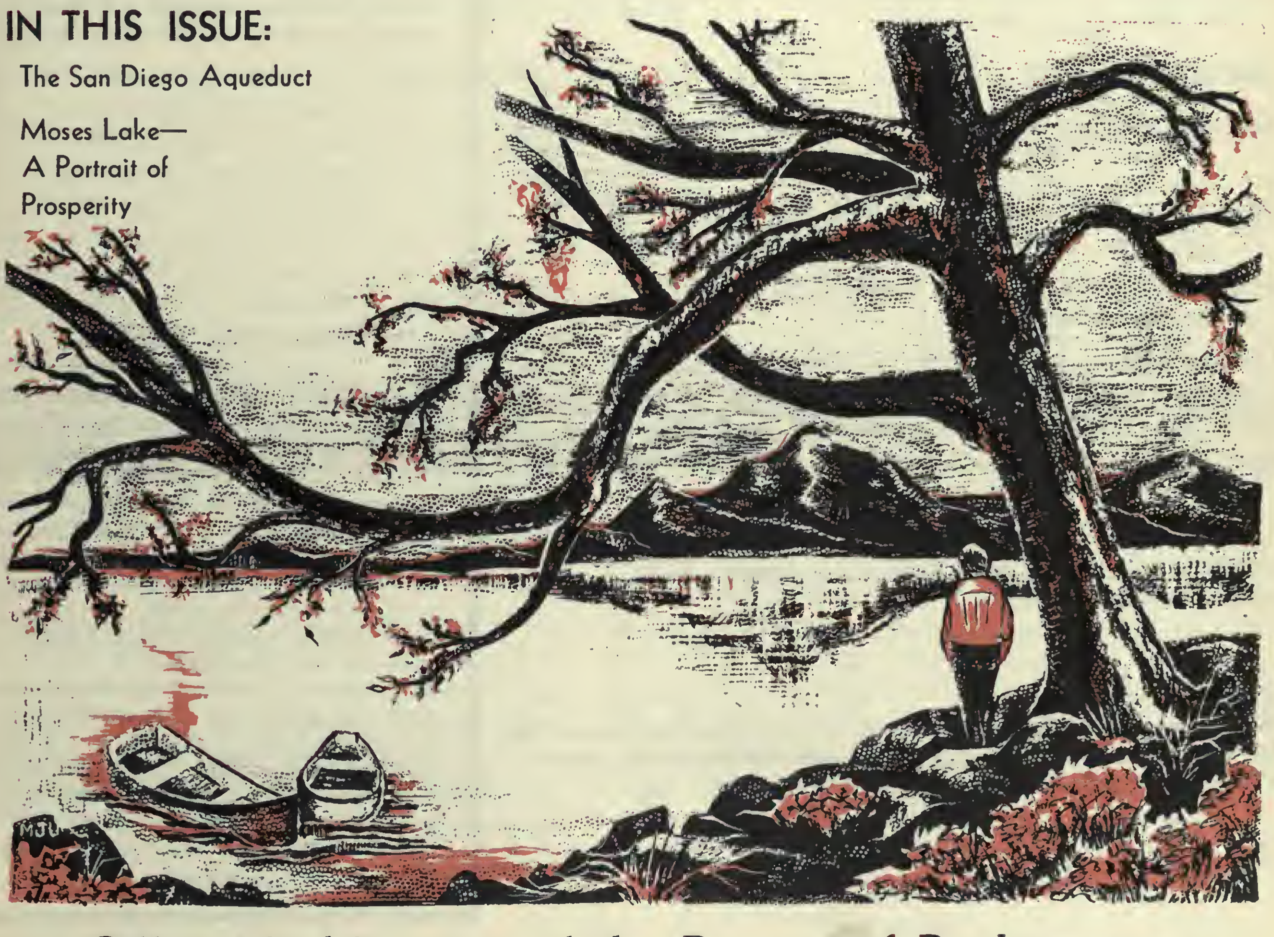

Official Publication of the Bureau of Reclamation

The Reclamation Era

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In this issue . . .

DESIGN AND ILLUSTRATIONS by Drafting and Graphics Branch
Bureau of Reclamation, Washington, D. C.

J. J. McCARTHY, Editor
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* * *

30 Years Ago in the Era

BUILD UP THE FARM

A farm unit is not a farm, but it holds the possibility of being made into a farm. This fact has often been overlooked by settlers. They have frequently used alfalfa as a cash crop instead of utilizing it to the fullest extent as a farm builder. They have been satisfied with the benefit derived from a rotation including alfalfa, when much greater benefit might have been secured by returning to the soil 80 percent of the fertilizer value and most of the humus-producing material of the foliage of the plant through the avenue of livestock. Roots and stubble are good for the soil, but roots and four-fifths of the foliage are much better.

At left, laying pipe on the Korsten ranch. It is installed 60 in. below grade to allow for deep plowing without damaging the line. At right, close-up view of pipe showing coupling which consists of a sleeve and two rubber rings. It provides a joint that is easy to install, remains tight, and is not affected by wetting or drying-out due to intermittent use. All photos in this article courtesy of Johns-Manville Corp.

RESCUE UNAVOIDABLE RUNOFF

by ELDREDGE MILLER, Sales Promotion Department, Johns-Manville Sales Corporation, New York, N. Y.

To save valuable water and reduce irrigation costs, many conservation measures are proving helpful. The lining of ditches and use of underground piping for laterals prevents the loss of water that occurs with dirt ditches. The leveling of land to better control rate of flow promotes the more efficient use of the water. The rotation of crops and other farm management practices improve the water carrying capacity and water penetration characteristics of the soil.

Also more attention is being given to better regulation of irrigation water from the farmer's head ditch through the use of syphon tubes which now may be obtained on the market in various sizes. The importance of saving water through better irrigation practices is well known to all irrigation farmers.

However, if under unusual conditions it is found that considerable water reaches the bottom end of a field, a method of preventing this tail water being wasted is being given increased consideration. This is known as the tail water pump-back system.

The construction of a typical pump-back system is shown in the accompanying pictures taken on the Jim Korsten ranch near Stanfield, Arizona.

In this system, the tail water from the various fields is gathered into a sump or pond at the low point of the irrigation area. From there, the water is pumped to a high elevation on the farm. Then, this reclaimed tail water is discharged and redistributed through the fields again. The main elements of the system are: the sump, the pickup box, the pump, the engine or motor, the pipe line and the discharge box.

The sump measures 1,200 feet long by 15 feet wide at the bottom and 40 feet wide at the top. It is 15 feet deep at the low end and 4 feet deep at the high end. The capacity is approximately 2,000,000 gallons or about 6 acre feet.

The pickup box is at the deep end of the sump. It is built with concrete blocks. There is a 36 by 40 inch inlet at the bottom. At the top are the engine and pump which pick up the water and send it through the 3,100 foot pipe line. At the end of the line is the discharge box from which the reclaimed tail water is fed back into the irrigation ditches.

A system of this sort is not cheap, but on the other hand, it is not exorbitant in cost. Experience shows that a pump-back system frequently can be paid for with one year's savings on the cost of irrigation water. That may seem

like quite a claim, but remember that the price of irrigation water to a Southwestern farmer can run as high as $10.00 per acre foot.

Of course, no two farms are alike so the experience on one cannot be duplicated exactly on another. However, some generalizations can be made about Southwestern farms where tail water pump-back systems are now being used successfully.

The land is relatively flat. Slopes of the natural terrain are from 5 to 35 feet to the mile. Pump-back pipe lines run from 500 feet to a mile in length. The amount of tail water, depending on type of soil and slope of land, averages 500 gallons to 2500 gallons per minute. Therefore, these systems utilize small 5 to 15 horsepower electrical ditch water pumps, pumping through pipes which range from 6 to 16 inches in diameter.

In many instances, the pipe line can run along the roadside where the pipe can be installed at any time.

In other situations, it may be more economical to route the line across fields. Then the line must be put in between crops and buried deep enough to prevent damage by cultivating machinery. A depth of 3 to 5 feet is generally enough.

When it comes to type of pipe, each farmer will have his own ideas. But, since the pipe line is such a major part of the system, there are several important requirements which should be kept in mind.

The pipe should be corrosion resistant since tail water has considerable quantities of chemical fertilizers dissolved in it which can re-act with some materials and shorten the life of the pipe drastically. Also, the pipe should be equipped with couplings which will stay permanently water tight since the entire objective of the system is to recover expensive water.

Strength should also be considered. The pipe must not crush when subjected to the loads of heavy farm machinery. And, the pipe used should provide a maintenance-free line since any

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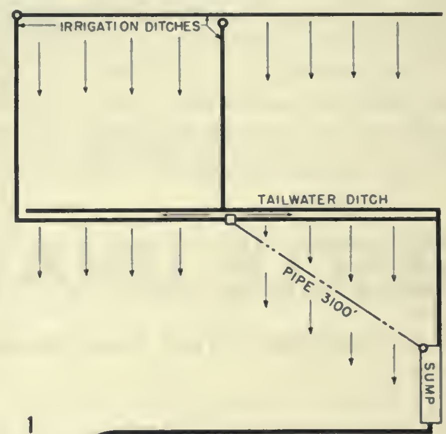

(1) Diagram showing tail water pump-back system. Tail water is picked up from full section of land by means of two tail water ditches which empty into a sump. Water is then re-pumped through underground pipe line to be redistributed over lower half of the section. (2) Pickup box at end of sump where water is collected. (3) Digging the sump where water is collected. (4) Completed sump for collecting water from irrigation system. Note connection at right leading to underground pipe line through which the water is pumped to high point on the land for reuse.


3


4

The San Diego Aqueduct

by J. P. JONES, Regional Director
Region 3, Boulder City, Nevada

SPLENDIDLY DISREGARDING TOPOGRAPHY, the Aqueduct sweeps over the hills and into the valleys, through pastureland, orchards, and semi-suburban development. ***Photo by J. M. Welsh, Bureau of Reclamation.***

Water was a problem to Junipero Serra and his followers from the time they first set foot in the San Diego area in 1769 to establish a Franciscan outpost of Christianity. In the years which have elapsed, the water problem has become no less pressing but much more complex. During these years, the agencies responsible for supplying water in the San Diego area developed local supplies, first from wells, and then from surface water sources. The area of surface water supply was limited to the western slope of close-lying coastal range of mountains. These mountains fall away on the east to what was until comparatively recent years a barren waste lying below sea level known as the Salton Sink, now become the richly productive Imperial Valley.

Beyond the coastal range and beyond the Salton Sink lay the Colorado River, long an erratic but abundant potential source of water but for many years beyond physical and economic reach of the San Diego area. With passage of the Boulder Canyon Project Act, the Colorado River water supply could be made firm by storage in Lake Mead above Hoover Dam and the physical means of carrying that water to the eastern foothills of the coastal range made available in the All-American Canal. Foreseeing full development of the local water sources, the City of San Diego entered into contracts with the United States for storage of water in Lake Mead and for capacity in the All-American Canal. The contracts were executed in the early nineteen-thirties, at which time it was considered that the local water sources would provide full supply with safety for a considerable period. This period was shortened drastically by the expanding military and manufacturing activities in the San Diego area during the early war years.

In May of 1943, the City and County of San Diego entered into contracts with the United States which provided that the Bureau of Reclamation make investigations to determine the means and cost of bringing Colorado River water to the San Diego area. During progress of these investigations, the problem of sufficient water supply became so acute and alarming that the matter was called directly to the attention of the President in 1944. He appointed a committee to study and report on the question. The committee, on the basis of the investigations so far made by the Bureau of Reclamation, recommended immediate construction of a connection to the Metropolitan Water District's Colorado River aqueduct in preference to the alternative connection to the

All-American Canal. The President, on November 29, 1944, so directed. Construction was to be at half ultimate capacity. The Bureau of Reclamation was directed to design and the Navy Department to construct the aqueduct. The work was undertaken as directed and the first Colorado River water reached the San Diego area on the 26th of November 1947. This part of the aqueduct was known as the first barrel.

The San Diego County Water Authority, an association of cities and water districts in San Diego County, was organized on June 9, 1944. This organization contracted with the United States to repay the costs of construction and to assume operation and maintenance of the aqueduct. Subsequently, the San Diego County Water Authority joined The Metropolitan Water District of Southern California under terms which provided for joint operation by the two agencies. Beginning in December 1947, the aqueduct was operated almost continuously to full capacity. A period of deficient rainfall, which decreased the local supplies, forced greater and greater dependence upon Colorado River water for immediate use rather than as a reserve source of water. This happened at a time when increased military and manufacturing activities due to the Korean hostilities had placed additional drain on the water supplies of the San Diego area.

Acting to augment the reserve supply of water, the San Diego County Water Authority entered into a contract with the United States on April 25, 1949, under which the Bureau of Reclamation undertook investigation of the location and cost of a second barrel which would bring the aqueduct to full capacity. The Authority pressed for authorization of the construction of the second barrel through the Department of Defense and authorization for construction by Department of the Navy was made by Public Law 171 of the 82nd Congress on October 11, 1951. The Department of the Navy, at that time heavily burdened with military construction activities, asked the Bureau of Reclamation to design and construct the second barrel.

On October 21, 1951, the interested agencies, consisting of the San Diego County Water Authority, The Metropolitan Water District of Southern California, the Department of the Navy represented by the District Public Works Office, Eleventh Naval District, and the Department of the Interior represented by the Regional Director's Office, Region 3, met in San Diego to discuss means of getting construction of the second barrel under way as soon as possible. The conferees had early success in agreeing upon major questions which would permit the work to go forward. Public Law 171 prohibited expenditure of funds appropriated to the Department of the Navy for this work until a repayment contract had been entered into with the San Diego County Water Authority and its constituent members. To prevent delay in surveys and designs, the County Water Authority advanced under formal agreement enough money to permit the Bureau of Reclamation to start at once on this work. The first construction contracts were awarded on September 8, 1952, slightly short of eleven months after authorization. The entire aqueduct was under contract award by December 15, 1952. The second barrel was placed in full service on October 2, 1954, and all construction was declared completed and the works turned over to the Navy on January 10, 1955.

The San Jacinto-San Vicente aqueduct, to use its official name, originates by connection to the Colorado River aqueduct of The Metropolitan Water District of Southern California, near the town of San Jacinto in Riverside County, California. From point of connection, the aqueduct extends southward through Riverside County into

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SECOND BARREL of the San Jacinto-San Vicente Aqueduct completed so as to be usable for its full length on October 2, 1954. Commemorating the occasion (l. to r.), Richard S. Holmgren, General Manager and Chief Engineer, San Diego County Water Authority; Fred A. Heilbron, Chairman of the Board Authority; Dean Howell, San Diego County Supervisor; Regional Director E. G. Nielsen, Region 3 (now Assistant Commissioner), Bureau of Reclamation; and Captain C. W. Porter, U. S. Navy. ***Photo courtesy San Diego Union.***

TWIN METAL FLUMES over Happy Canyon on the Montrose and Delta Canal.

AUTHOR can be seen in right tube. These replaced Happy Canyon flumes.

Facelifting at Uncompahgre

by JESSE R. THOMPSON, Manager-Treasurer, Uncompahgre Valley Water Users' Association

ABOUT THE AUTHOR

There is probably no one better acquainted with the Uncompahgre River Valley in Colorado and with the Uncompahgre Reclamation Project than Jesse R. Thompson, now in his eighteenth year as Project Manager.

He began his long association with the Uncompahgre Project in 1909. In 1910, while working as a ditchrider, he regulated the first water turned through the 6-mile Gunnison Tunnel, then the longest tunnel for the diversion of irrigation water.

From 1910 to 1932 he advanced steadily, holding positions as Hydrographer, Watermaster, and General Foreman, gaining experience that would be invaluable to him in the future. He studied at night and obtained the degree in engineering that qualified him for the position of Project Manager.

The Uncompahgre Valley Water Users' Association has launched a program of rehabilitation on a number of major and important structures on the Uncompahgre Project in western Colorado. Funds for the work are being raised currently by nominal additional assessments and construction is being accomplished by project maintenance forces.

The Uncompahgre Project, originally called the Gunnison Project, was one of the first five reclamation projects recommended for construction to the Secretary of the Interior on March 7, 1903, and approved by him on March 14, 1903. Construction was started in July 1904 and the first water was delivered through project works in 1908. The project was substantially complete in 1922 except for drainage construction and building of Taylor Park Dam which was completed in 1937. Care of the project, operation, and maintenance were assumed by the Uncompahgre Valley Water Users' Association in 1932. The irrigable area of about 72,000 acres is served irrigation water from natural flow of the Gunnison River and the Uncompahgre River, and by stored water from the 106,230 acre-foot Taylor Park Reservoir. The 5.8-mile long Gunnison Tunnel carries water from the Gunnison River to the Uncompahgre Valley where a system of canals and laterals totaling 568 miles in length serves the farm lands. An unusual number of structures are necessary for water conveyance and control because of the steep valley slopes, mesa formations, and highly erosive soils on the project area. Deterioration of structures is increased by alkali conditions in sections of the project area and the requirement for some operation during winter periods for watering livestock. Practically all the original structures on the canal system were timber.

On December 7, 1933, the Federal Emergency

HEADWORKS of GH AND GK laterals with wasteway structure in foreground, due for replacement under rehabilitation program.

METAL FLUME over Cedar Creek on the East Canal also scheduled for replacement under water users' facelifting program.

Administrator of Public Works approved allotments for rehabilitation of the South Canal and making of general repairs and replacements to other portions of the irrigation system, and construction of Taylor Park Reservoir. On August 6, 1935, an allotment was made for construction of drainage works.

In September 1950 the Board of Directors of the Association, the Project Manager, and Bureau personnel made an inspection of major structures to obtain first-hand knowledge of the need for a rehabilitation program and nine structures were considered to be in a condition that would necessitate replacement in the near future. Another inspection was made in 1951 and the Association decided to proceed with a rehabilitation program using its own funds and utilizing project forces for construction. It was decided to spend a minimum of $20,000 a year and assessments were levied accordingly.

The need for replacement of any structure on the project is governed by operating efficiency, annual maintenance costs, and consideration of the risk involved in case of failure. In some cases structure failure could mean a total loss of all crops on lands supplied with water through the structure.

In entering upon a program of rehabilitation, the first consideration should be the type of structure. The futility of trying to operate a project by replacement of existing facilities with short-lived structures has become forcibly apparent during the 46 years of project operation. Where formerly structures were built with a life expectancy of from 20 to 30 years, structures can now be built economically to last for a period of from 75 to possibly 100 years.

In choosing the type of structure, time available for replacement is to be considered. Where a new structure can be placed near the old structure during the irrigation season without interference with water delivery, the need for hurried construction during the winter months is eliminated.

Another factor to consider is whether the job can be handled with local project crews and equipment. If it can, a considerable saving can be realized.

The next consideration is how long will a structure last without excessive maintenance. Reinforced concrete structures properly placed and using the proper mixture of concrete aggregates will fill the requirements as to life expectancy provided that alkali action is not a hazard.

The main types of structure to choose from are: reinforced concrete, pipe or long span tubes with concrete inlet and outlet, sheet metal with wood or metal substructure, and wood.

Using these criteria we have made satisfactory progress on replacement and improvement. The first structure was replaced during the winter of 1951–1952. The new reinforced concrete flume at mile post 6.35 on the Ironstone Canal replaced the original wood flume over Dry Creek.

A concrete structure was chosen for this point because of its durability. The old substructure was used for supporting forms (by lowering floor of old structure); water could be fed from Dry

Creek into the Ironstone Canal downstream from the old flume for winter stock. It could be built by project crews between season's run of water; soil was such that alkali action would not be a problem; and such a flume would not be subject to leakage. The new flume has a span of 70 feet across the creek with outlet section 49 feet long and inlet section 35 feet long. It rests on two piers excavated to hard shale. The structure is 8 feet wide, 5 feet 6 inches deep, and has a capacity of 300 second feet.

The next major structure to come under our program was the metal twin flume over Happy Canyon Creek on the Montrose and Delta Canal at mile post 5.43. This large structure had a capacity of 400 second-feet and was 252 feet long with concrete inlet and outlet sections. The height from ground surface to top of the old flume was about 35 feet. The old flume was size 204 sheet metal with timber substructure. Built in 1913 it has given 41 years of service, but maintenance has been excessive for many years and natural deterioration of the substructure has reached such a state that the risk of losing crops on the 22,000 acres served by the canal if the structure failed has made it mandatory to replace it.

Consideration was given to a concrete flume or siphon for this structure but was abandoned. This decision was due principally to the fact that the cost would be excessive and work would have to be contracted rather than handled by project crews with project equipment.

The final choice was twin long-span metal tubes 8 feet in diameter. It is set low enough to run full when carrying a small head for winter stock water to prevent freezing solid in winter and running water over the canal bank above the structure.

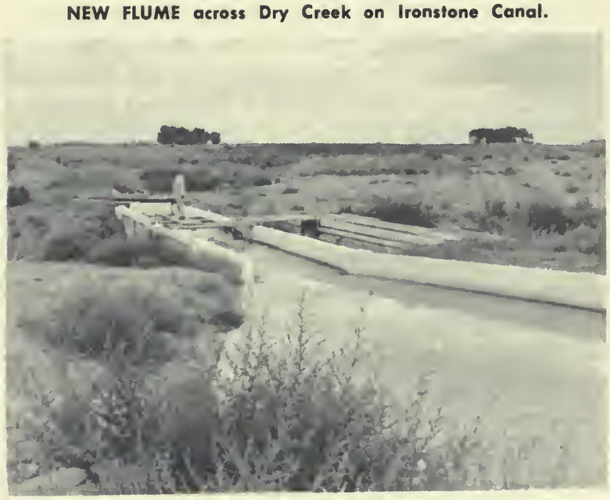
The new structure has a center span of 90 feet with end spans of 77 feet, a 7-foot section at each end for expansion joints, plus a concrete inlet and outlet.

A major problem was sinking four 6-foot diameter tubes to support the foundation under each of the two center support piers. Large sandstone, mud, and quicksand were encountered. Water was a problem, pumps had to be used for the last 12 feet of excavation at each pier. A good foundation was reached at the same elevation on both piers and consisted of good solid gravel about 30 inches above solid sandstone. End foundations and inlet and outlet concrete structures were set on solid sandstone.

Some of the rehabilitation work being performed is coordinated with a soil and moisture conservation program in which we and the Bureau of Reclamation are cooperating. During the past year the cooperative program included the replacement of an old wooden culvert on the Loutzenhizer Canal at mile post D2.28 where it crosses Montrose City Arroyo, and the control of channel erosion at that point. Although the Association was primarily responsible for replacing the culvert and the Bureau responsible for controlling erosion in the channel, personnel, equipment and other facilities were pooled to perform the overall job more efficiently and effectively at a minimum cost. The new culvert is 107 feet long and with a 7-foot diameter of heavy corrugated pipe. In addition to carrying normal and flash flood flows of City Creek Arroyo under the canal, the culvert also functions as a drop structure in which the arroyo channel is lowered 9 feet. This adds considerable stability to the arroyo channel. To further prevent erosion the arroyo channel was straightened for a distance of about 300 feet both above and below the culvert. In addition, for about 40 feet below the culvert, heavy sandstone riprap has been placed on the bottom and sides of the channel.

Rehabilitation of major structures and participation in a conservation program to protect these and other structures on the project increases the workload and expenses considerably above those encountered in the normal operation and maintenance of the project, but it will be satisfying to project farmers and us to have accomplished our goal with a minimum of cost and outside assistance. ###

NEW FLUME across Dry Creek on Ironstone Canal.



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E. G. NIELSEN NAMED ASSISTANT COMMISSIONER

Edwin G. Nielsen, Regional Director of Region 3, and a Reclamation engineer with many years' experience, took office as Assistant Commissioner for Irrigation and Power of the Bureau of Reclamation on March 10, 1955.

The appointment was made by Secretary of the Interior Douglas McKay on Reclamation Commissioner W. A. Dexheimer's recommendation. Mr. Nielsen succeeds Harvey F. McPhail who retired to enter private practice as an engineering consultant. In his new post, Mr. Nielsen will be part of the Commissioner's staff in Washington.

He served as Regional Director of the Bureau's Region 3 with headquaters at Boulder City, Nevada, since 1952. Prior to that he had been Assistant Regional Director since 1950.

Commissioner Dexheimer said that Mr. Nielsen's administrative experience as a Regional Director particularly suits him to his new responsibilities. Region 3, which embraces the Lower Colorado River area, contains some of the most outstanding water resource development projects in the world. Within the Region are Hoover Dam, highest concrete dam in the world, Lake Mead, the world's largest man-made lake, and the All-American Canal, the largest irrigation canal in the United States. The Lower Colorado River with Hoover, Davis, Parker and Imperial dams is one of the most highly developed and utilized among the major rivers in the world.

Mr. Nielsen, who has been with the Bureau of Reclamation 21 years, obtained his B. S. degree in engineering from the University of Iowa in 1926. After working with private companies for five years, he served with the Public Service Commission of Missouri from 1931 to 1933 as assistant engineer. He joined the Bureau of Reclamation as assistant engineer in Denver in February 1934. In May 1936, he was promoted to associate engineer and in June 1938 became engineer at Salt Lake City, Utah.

In 1942, he was transferred back to the Denver office where he acted as Chief of the Hydrology Division. In 1945 he became Regional Planning Engineer for Region 3. He held this position until becoming Assistant Regional Director at Boulder City, Nevada, in 1950.

J. P. "JACK" JONES SUCCEEDS NIELSEN

As this issue went to press, Secretary of the Interior Douglas McKay announced the appointment of J. P. "Jack" Jones as Regional Director, Region 3, succeeding Mr. Nielsen.

This appointment was also made on the recommendation of Commissioner Dexheimer. Mr. Jones, a career engineer in the Bureau, has been Regional Engineer at Boulder City since 1951. After graduating from Colorado A & M College with a degree in Civil Engineering, he went to

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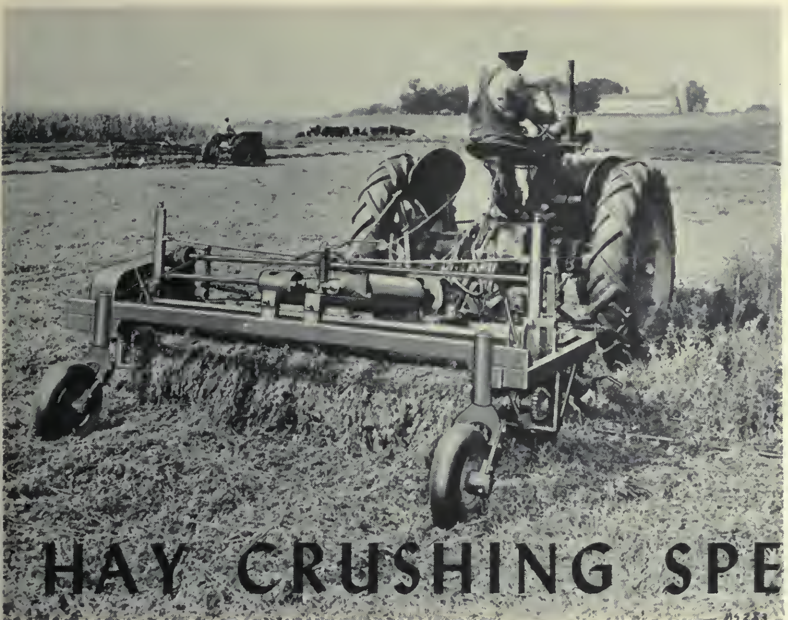


LATEST MODEL hay conditioner in ACTION.
Photo courtesy Meyer Mfg. Co., Morton, Ill.

HAY CRUSHING SPEEDS CURING

by J. H. RAMSER and R. W. KLEIS

Note: J. H. Ramser, Associate in Agricultural Engineering; and R. W. Kleis, Instructor in Agricultural Engineering, both at the University of Illinois.

(Editor's Note: We are indebted to the University of Illinois College of Agriculture for permission to reprint the following Circular #639 which they published originally under the title "Hay Crushing FOR FASTER FIELD CURING.")

CRUSHING HAY IS AN EFFECTIVE WAY to get faster field curing and so avoid some of the weather hazards that reduce the quality of a crop or even completely ruin it. This article describes the hay crusher, a relatively new machine, and reports on tests showing how it can be used and what benefits can be expected.

The crusher cracks the stems lengthwise and reduces them to the equivalent of several smaller ones. The crushing also opens up the moist inner parts of stems to bring them into more direct contact with the air. As a result, the stems dry rapidly and at almost the same rate as the leaves.

HOW THE CRUSHER OPERATES: The crusher consists of a pair of steel rollers, held together by adjustable springs. A pick-up unit lifts the swath and feeds it through the rolls. After being crushed, the hay is dropped back onto the stubble, still in the swath.

Most crushers follow directly behind the tractor and crush the swath which was mowed the previous round; an extra round is then needed to crush the last swath in the field. With this arrangement, you have less side draft than with the earlier machines, which were offset and crushed directly behind the cutter bar. Also you do not have to drive on the hay after it is crushed.

THREE CHOICES OF EQUIPMENT: You can buy a mower-crusher combination unit. This gives you a complete outfit, consisting of a standard mower—usually a 7-foot cut—with a crusher unit designed around the same power-transmission system.

You can use the mower you have for cutting and buy a separate crusher. This calls for the lowest investment in new equipment, but means that mowing and crushing have to be done as separate operations. Although twice over the field costs more in time and money, it may be worth it if you already have a good mower and a relatively small acreage of hay. Another advantage of this method is that you can use a smaller tractor.

You can find out whether a separate crusher can be connected to your mower. Your dealer will know if your mower is made so this can be done. At present only one manufacturer makes

this type of crusher and it will fit only one particular make of mower.

(Editor's note: The crusher manufacturer referred to by the above note in 1952, is Meyer Manufacturing Company, Morton, Ill. Another manufacturer of hay crushing machines is John Bean Manufacturing Company, Lansing, Mich.)

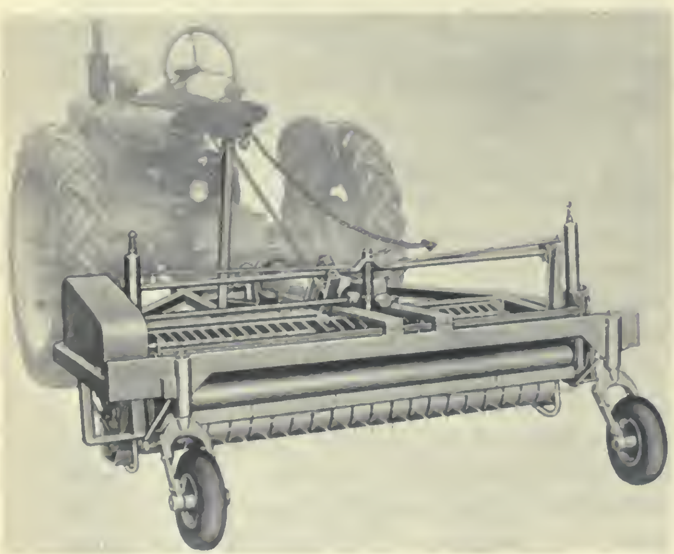
COST CONSIDERATIONS: Prices differ somewhat from place to place and with various types and models. The three choices of equipment mentioned above differ considerably in cost. The difference in cost between a separate crusher and a mower-crusher combinatioin of the same make is approximately the cost of the mower.

You may find that you have a large enough acreage of hay to justify the purchase of a crusher to put up better hay and avoid damage or complete loss due to bad weather. Saving 20 or 25 acres of hay that would otherwise be ruined will pay back much of the cost of a crusher unit.

If you do not grow enough hay yourself to pay to have a crusher, you might consider the possibility of owning one jointly with one or two neighbors or supporting a custom crusher in your community.

Power needed to operate a crusher: Both the mower and the crusher are operated from the tractor power take-off. A two-plow tractor provides enough power under nearly all operating conditions. In extremely hilly or soft fields, a three-plow tractor may occasionally be required.

Two main adjustments: Adjust the pick-up mechanism so that it picks up the swath cleanly and without gathering trash out of the stubble.



The fingers should, of course, clear the ground during normal operation.

Adjust the roller pressure according to the kind of hay, the stage of development, and the yield. Tighten the springs enough to crush the stems but not enough to squeeze out the plant juices. The juice contains feed value which is lost if it does not dry in the hay.

SOME RESULTS of research on crushing: Research work done at various times since 1932 by the Illinois agricultural experiment station has brought out several points about crushing.

Crushed hay dries in one-third to two-thirds the time required for uncrushed hay. Crushing reduces the drying time by about half for alfalfa and clover. Coarse-stemmed soybean hay when crushed dries in about a third the normal time. Typical results of drying tests were (third column is percentage decrease in drying time due to crushing):

	Hours of Drying Time		
	Crushed	Uncrushed	
Alfalfa, first cutting	25. 3	52. 3	51. 5
Alfalfa, second cutting	23. 6	45. 3	48. 0
Red clover	23. 3	45. 3	48. 5
Soybean hay	49. 9	127. 0	60. 7

Crushing has no effect on the loss of nutrients in storage. Although there is considerable loss of carotene during the storage period, tests indi-

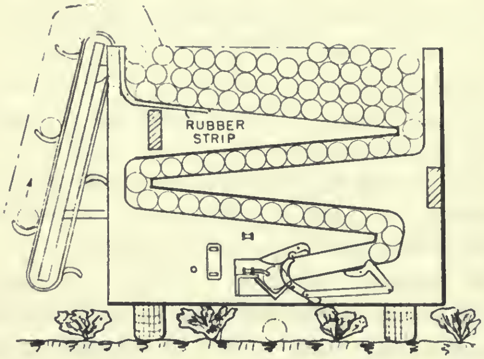
Continued on page 52

Left, Hay conditioner less mower. Above, Crushing reduces large stems to equivalent of several smaller ones. Photos courtesy of Meyer Mfg. Co., Morton, Ill., and Food Machinery and Chemical Corp., Lansing, Mich., respectively.

STREAMLINED PIPE MOVING

For years the task of moving sprinkler irrigation pipe from one section of the farm to another has been an arduous, time consuming and expensive operation. Now we learn that one Mr. Ralph M. Sanders, contractor and builder, Pittsburgh, Pennsylvania, has invented a machine which will do this work almost automatically.

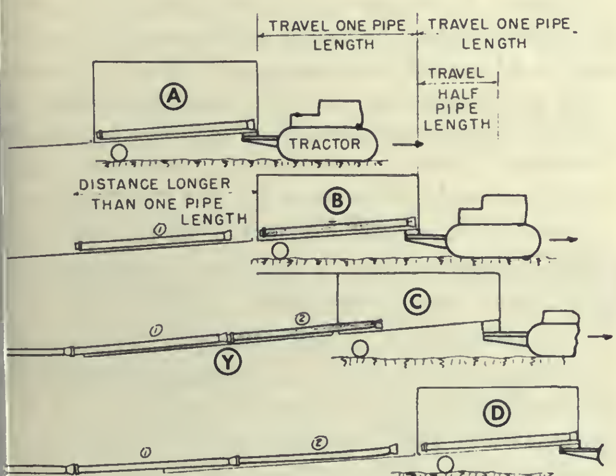
Mr. Sanders, who has applied for a patent for his yet unnamed machine got the idea for his laborsaver while watching three men engaged in transferring pipe on a farm in Butler County, Pennsylvania. Mr. Sanders who operates mainly in Pittsburgh and its environs said "I was amazed when I saw the amount of labor necessary to transfer this pipe." Two men were loading and reloading the pipe while a third was driving the tractor hitched to a trailer. He continued "the idea stuck with me that there certainly must be an easier, less costly, and perhaps simpler way of doing it." Sanders who said "I am not an engineer, just a tinkerer" finally went to his workshop in his basement determined to apply some American know-how to what he was now considering almost his personal problem, despite the fact he was not a farmer and probably never would be one.



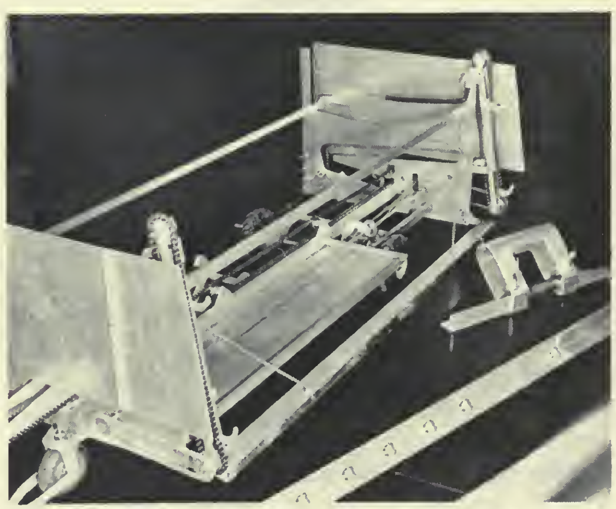
PIPE MOVER FULLY LOADED.

Some time later he came up with a scale model of a mechanized pipe-handling trailer. The model is built to exact scale and is made of practically all aluminum. For demonstration purposes, Sanders uses small lengths of aluminum piping or tubing.

The trailer, loaded with pipe, rolls along behind a tractor, distributing the pipe down a rear ramp. The pipes are fed one at a time from the top to



PIPE MOVER In ACTION (A) Position one: Pipe (1) is ready to be pushed out of machine. (B) Position two: After travel of one pipe length first pipe has been pushed out and second one has dropped into trough. (C) Pipe #2 is shown having been moved out but still not coupled with pipe #1. Ramp has elevated section at point (Y) which then raises pipe #2 in line with pipe #1 and this causes the two pipes to be coupled. (D) Pipe #2 is fully pushed back and pipe #3 is rolled into trough. *Illustrations courtesy of Mr. Sanders.*



SCALE MODEL of mechanized trailer Sanders has invented to speed laying pipe.

the bottom of the trailer or carriage so that a single pipe rests in the cradle or trough from which it is expelled rearwardly by a "dog" carried by a chain driven from the wheels of the carriage. This trailer arrangement even hooks the pipe together as it distributes it.

Thus, the pipe is laid on the ground fitted together and needs only the addition of sprinkler heads before going into service. After the pipe has been used in one area, it can be uncoupled, reloaded onto the machine and transferred to another area for irrigation purposes.

Mr. Sanders advised us that the full-sized trailer could hold a thousand feet of six-inch pipe. Should large farm operators require a bigger pipe hauler, he said the machine could be built longer and wider to accommodate their needs by adjusting the size of storage slots.

The reloading of pipe is also greatly expedited by use of this machine. Pipe sections are placed on a loading elevator at the side of the "rig". It is then carried upward and loaded into the storage space.

The machine is not yet in production; however, a working model will soon be built. If field tests demonstrate the advantages envisioned by the inventor, it would be an important labor saver in sprinkler irrigation. Accordingly, we considered the subject matter of sufficient interest to irrigation farmers to justify inclusion in this issue of the *Era*. ###

Rescue

Continued from page 30

shut-down during the peak irrigation season could defeat the purpose of the plan.

Finally, the initial cost of the pipe should be low enough to permit rapid amortization. No more than five years should be required to pay for the system. That is important since many farms are leased for five year periods, and if the lessee is participating in the cost of the system, he is not interested, naturally, in anything beyond the term of his lease.

In the case of the Korsten ranch, the pipe selected was an asbestos-cement pipe. It met the requirements just mentioned and also was easy and economical to install because of its light weight and long lengths which simplify handling. Also, the couplings designed for use with this pipe provide a watertight joint that can be quickly assembled without need for any auxiliary materials. Another feature of this coupling is its flexibility. It can be deflected as much as 5 degrees so the line can follow the changing contours of the terrain where the pipe is installed.

Now that their pump-back system is operating both Jim Korsten and his lessee are enthusiastic about the results. They figure that their reclaimed water, which is already paid for, is put back on the ranch's 320 acres at a cost of less than 50 cents an acre foot.

They are convinced that a tail water pump-back system is a remarkably quick and inexpensive method of improving a water situation. Furthermore, such a system is a valuable aid in helping to improve that water situation in a whole area where unavoidable runoff occurs, so that there will be more adequate supplies for all. ###

ATTENTION SUGAR BEET GROWERS

The following information received from the Department of Agriculture may be of interest to you and is hereby published accordingly:

"The Sugar Act of 1948, as amended, establishes an annual marketing quota for the domestic beet sugar area of 1,800,000 short tons of sugar. Moreover, it requires that individual farm proportionate shares (acreage allotments) be established when the indicated sugar supply for an area will be greater than the quantity needed to fill its quota and provide a normal carryover inventory. Since production in the beet sugar area reached 1,873,000 tons for the 1953 crop and is expected to exceed 2,000,000 tons for the 1954 crop, the Department is required to restrict 1955 crop sugar beet production.

"The Sugar Act provides, in establishing proportionate shares, that consideration be given to past production on the farm of sugar beets marketed for the extraction of sugar or liquid sugar and the ability to produce such sugar beets. Since the criteria are applied to production history, the shares for established producers will be based on their record of production during a base period. Although provision is made for new growers, the acreage available for such growers is necessarily limited." ###

Moses Lake—
A PORTRAIT OF PROSPERITY

by OMAR L. BIXLER, Secretary-Manager Moses Lake Chamber of Commerce

For a stimulating look at a genuine frontier springing to life with atomic-age speed, consider the dawning years of the Columbia Basin Project in eastern Washington.

To appreciate this 600,000-acre blossom in our western agricultural scene, take one prospering community, Moses Lake, in the northern part of the project area and contemplate with as much equanimity as possible the current growth.

Moses Lake is not the only town that is blooming on the firm foundation of Basin irrigation, but the first one which has taken advantage of the mighty updraft of the economic factors so favorable for permanent growth. At the arrival of irrigation water from Grand Coulee Dam in Reclamation's "Golden Jubilee" of 1952, Moses Lake counted up 4,244 citizens in the city limits, and had the Larson Air Force Base on the outskirts as an added stimulus fitting nicely into the gap between Project construction and full farm trade area development. In fact, everything happened just right for Moses Lake. Called by every visitor a "sleepy little town on the lake," with 326 souls in 1940, the place fairly exploded with growth since 1949. Timing was perfect for a repetition of boosts that continue into a spiral, and now forecast to level out around 1980. The best minds that have tackled the growth factors apparent at Moses Lake have set a "conservative" estimate of at least 30,000 for the city.

Growth is so fast, however, in this reclamation—commercial—industrial little town that the local Chamber of Commerce steadfastly refuses to make predictions on its own. Swarms of investors, inquirers, farmers, would-be small business people, all get the same treatment—a small mimeographed sheet handed to them without comment, when they ask "what is the future going to be." On the sheet is a table of figures of the past decade. Only three of the columns have figures available for 1940, being population 326, school enrollment 194, telephones 89, corresponding data for 1954 are: population 8,000; schools, 3,625; and phones, 3,892.

MOSES LAKE, an unincorporated desert village in 1929.

MOSES LAKE, a thriving prosperous community in 1954.

UTAH-IDAHO Beet Sugar Factory, Moses Lake, built at a cost of about $7,000,000.

Residential platting in the past year has caused annexation to the city of more than 1,600 acres, and city limits contain 4,500 acres in 1955, of which slightly more than a thousand acres is in water on two arms of the lake.

In only a few months, platting of residential areas has all but swallowed up ten miles of the lake shoreline which the people look to as the chief living advantage in the semi-arid area now becoming an agricultural garden. Even a few sections of sand dunes running south and west from the lake are suddenly an outdoor asset as commerce crowds the city outward and reclamation crowds in on other land which was arid space a few years ago.

The industry which set the pattern of the community's farm-based growth was the Utah-Idaho Sugar Company which set their $7,000,000 modern refinery three miles east of the center of Moses Lake. The first sugar from Columbia Basin crops was made in October 1953. In 1954 the new plant really got in gear, hitting a pace of more than 2,800 tons of beets cut per day in a short, fast "campaign" closing at the end of January 1955.

Scientific studies of growth in the area have been made by Puget Planners Inc. of Seattle in connection with plans for meeting school needs. Their surveys ran into so much deep water that the analyst-manager of the firm, John Nordmark, said they had to "rebuild their crystal ball" and find new methods for calculating growth in a new area. One example will suffice to illustrate the problem. With a state-wide average age of mothers-with-the-most-children-in-school of 46 years, the average at Moses Lake of mothers-with-the-most-children-in-school was 31 years. And at the moment of calculation Moses Lake already had the highest family size in the State of 3.74. The growth of the farm and town families at Moses Lake foretells a future of families like olden time pioneers, but with modern facilities.

ONION HARVEST in Moses Lake, just one of the many contributions to agricultural trade.

All forecasts point to a booming but solid community rooted in a fortunate balance of diversified agriculture, agricultural industry, and a third powerful stimulus in the "bonus" aircraft industry. Boeing Airplane Company of Seattle, Washington, started flight-testing of the giant B–52 jet bomber in February 1955 at a new $10,000,000 plant at Larson Air Force Base. The company has also told the community that they consider the plant a "permanent extension" of their "Seattle manufacturing and modification" facilities. Modi-

A LAKESHORE HOME, CHURCH, and STORE represent the new architecture in Moses Lake, as the town builds rapidly but for the future. All photos in this article, except top two on this page, courtesy of the Author and the Moses Lake Chamber of Commerce.

fication work has already been announced for the Moses Lake Flight Center, which is equivalent to a manufacturing component of the local economy.

The Moses Lake People made more than token recognition of the incoming forces. First they took with enthusiam the opportunity given by the project development and land settlement offices of the Columbia Basin Project to celebrate the first major land drawing for veterans in 1951. They made a major publicity event of the occasion, despite a mid-day squall that produced an occasional 60 m. p. h. gust. Movies and publicity left no doubt that the Columbia Basin Project was launched for the benefit of veteran farmers as well as private developers. Then they organized a welcoming program for the veteran settlers when they came to select their farm unit in small groups. They encouraged the social integration of the first new farm settlers. The new farmers organized rural settlement clubs which are a recognized force in social assimilation. The Block 40 Club, the oldest, wields no small influence in settlers affairs; and others, such as Block 42 Club, are taking their place in farm programs. Moses Lake has made serious attempts to meet the social probems of incoming multitudes. By the time Boeing started work on their flight center there were 14,00 persons at Larson Base and in the town and suburbs.

A second major social program at Moses Lake was not agricultural but followed the consistent pattern of building a community for pleasant living. A program instituted by Larson Air Force Base and community leaders resulted in an Air Base—community relations program which has achieved nationwide attention in military circles.

A third problem of absorbing more than a thousand Boeing employees in first six months of 1955 is being met with the same sort of plans, and similar cooperation between leading community voices and industry officials. A long-time community figure dared to face a Boeing official who expressed amazement at his calm, unexcited, attitude with the remark, "why should I be excited after 14 years of this kind of thing." And he wasn't being funny. He had experienced the business growth from a couple dozen small "joints" to 450 business firms and independent operators in that 14 years.

Business was quick to believe in Moses Lake after the sugar plant sat down in the upper center of earliest irrigation. Building permit values went up from 1½ million dollars in 1951 to 3½ million in 1953, with a large proportion of these

three years in commercial building. Building was $8,298,000 in Moses Lake in 1954, mostly homes, while 400 more homes were built at Larson Air Force Base outside the city limits. In the first two months of 1955 the commercial buildings being designed and contracted assured again a rec-

ord construction year in the city. Four major chain store buildings were on the books or had property bought in that short time, and real estate prices in downtown Moses Lake hit figures that made the hardest realtor blush. As one man said, "the amazing thing is that they are still building."

The spiral of growth is seen in the comparative figures for 1953 and 1954 in these four additional items, bank deposits $4,927,000.00 to $6,821,149.58; postal receipts, $96,662.36 to $110,457.64; telephones, 2,951 to 3,892; and school enrollment 2,700 to 3,625. Between these two years, both school district and city assessed valuations rose 38 percent. All this on the basis of 610 irrigating farms plus less than 10,000 acres of the private Moses Lake Irrigation District.

Blocks 40, 41, and 42 adjacent to the city on the north and east enjoyed the early, rapid settlement of over 46,000 irrigable acres. With later irrigation blocks bringing in new farms for the coming six years, the city looks forward to a minimum of 1,800 full-time farms in Moses Lake's concentrated primary trade area.

Moses Lake no longer has to work up its own press clippings since roving writers have discovered the new land of opportunity. One industrial trade journal called Moses Lake "the kind of dream city you would build if you were starting from scratch. Today its business district will compare favorably with the most modern big city shopping centers." The same journal relates to the project by saying "the most astounding change, however, is not in the shining towns and cities, but in the land itself." A major oil journal saw it the same way, "from a drowsing desert village Moses Lake has become a city of wide, well-scrubbed avenues and blocks of smart modern shops. There are 18 churches (23 since that writer was there), a million dollar high school, and row after row of pastel-colored ranch houses, as neat and cheerful as toy building blocks." One writer reviewing the population increase quipped "This wasn't expansion, it was explosion."

In all this one of the key factors in building cities in the former desert, has been omitted because, outside of the sugar refinery, processing industries have hidden out. Apparently several firms are only waiting to see who jumps first in the Columbia Basin Project. They have waited until more than 100,000 acres are producing crops. They can't wait much longer, thinks Moses Lake, and other Basin Towns. ###

J. P. "Jack" Jones.

J. P. Jones

Continued from page 36

work for the Bureau as an instrument man on the Minidoka Project in Idaho.

He was Assistant Engineer from 1931–1935 during the construction of Hoover Dam. He subsequently worked on the Yuma and All-American Projects in Southern California and Arizona, reclamation surveys in Texas, and the Central Valley Project in California where he was office engineer during the construction of Friant Dam.

Mr. Jones has been located in Boulder City since the establishment of the Regional office there in 1945.

The announcement of the new Regional Director's appointment was made in Boulder City at a farewell party for Mr. Nielsen prior to the latter's departure for Washington. ###

YOUR MAGAZINE

Are there particular types of articles which you would like to see in the Era that we have not printed to date? If so, please let us know, and we shall do our best to comply with your wishes.

1955

WATER SUPPLY OUTLOOK

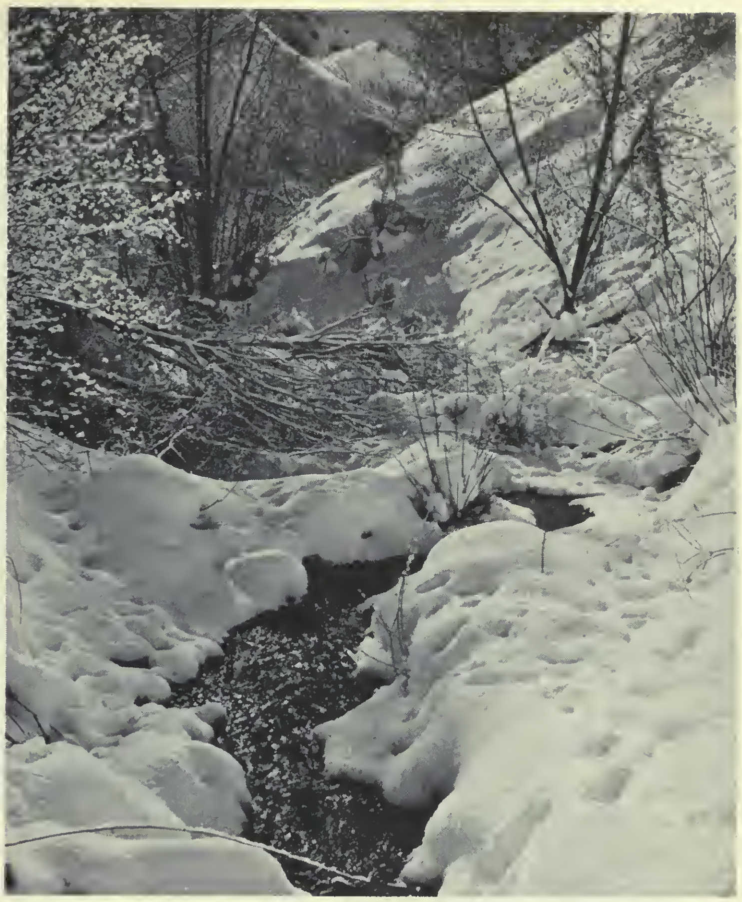
by HOMER J. STOCKWELL

Snow Survey Leader, Colorado Experiment Station, Fort Collins, Colorado

and

GREGORY E. PEARSON

Hydraulic Engineer, Soil Conservation Service, Salt Lake City, Utah



TYPICAL SNOWPACKS LIKE THIS ONE BRIGHTEN WATER OUTLOOK.

Streamflow from snowmelt will be less than average in the major river systems of the western United States during 1955. Runoff barely normal is expected in the extreme north and northwest. The decline in water supply outlook is gradual toward the south. In Arizona, New Mexico, southern Utah, large parts of Nevada and localized spots in California, extremely short water supply is in prospect. This is the summary of water supply conditions as prepared by the U. S. Soil Conservation Service and is based on April 1, 1955, observations at some 1,200 snow sources in the high mountains of the West.[1]

This analysis of April 1 snow surveys, reservoir storage and other factors affecting this year's water supply, again presented by the *Reclamation Era* through the courtesy of the authors, and *Mr. R. A. Work*, Head, Water Supply Forecasting Section, shows that runoff in prospect for irrigation, power generation, and municipal and industrial use will be adequate in some areas of the northwest, but will result in mild to severe water shortages elsewhere in the western United States.

In the following paragraphs the water supply is briefly reviewed and a chart showing current status of reservoir storage is included, for your information.

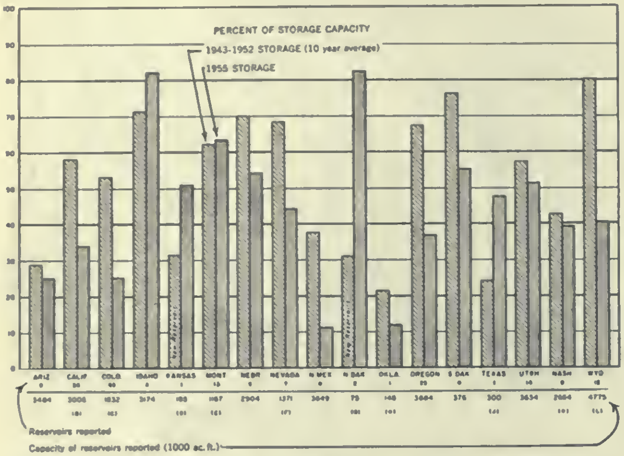
ARIZONA.—Arizona snowmelt runoff may prove the least since 1904, and possibly the least since records began. Precipitation on the headwaters of Arizona rivers was exceptionally light last summer and fall, while temperatures were considerably above normal. The soils were extremely dry at the start of the winter. Sparse winter snowfall contained insufficient water to offset the accumulated moisture deficiency. As a result practically all of the snow water was absorbed by the dry mountain soils without producing much runoff. Snow has already melted without perceptible increases in the minimum flows of the rivers.

Water carryover in reservoirs of the Salt River project is substantial and will be adequate to meet needs this year. However, the San Carlos project has a continued shortage of stored water, with less than 20,000 acre-feet, or about 13 percent of the 10-year average, now in storage. Lyman Reser-

[1] The Soil Conservation Service coordinates snow surveys conducted by its staff and many cooperators, including the Bureau of Reclamation, Forest Service, other Federal Bureaus, various departments of the several states, irrigation districts, power companies, and others. The California State Division of Water Resources, which conducts snow surveys in that state, contributed the California figures appearing in this article.

The U. S. Weather Bureau makes Water Supply Forecasts at numerous gauging stations, such forecasts being estimated principally on the basis of measurement of precipitation. The Weather Bureau forecasts are for the water year (October–September, inclusive), whereas snow survey forecasts are for the irrigation season only.

RESERVOIR STORAGE SHOWN IN PERCENT OF CAPACITY



RESERVOIR STORAGE AS OF APRIL 1, 1955. Explanation: (a) Most State averages for reported reservoirs are for a full 10-year period, but in a few cases reservoirs with shorter records have been included. (b) Does not include Shasta, Millerton, Isabella, Folsom, or Pine Flat Reservoirs (combined capacity 7,092,000 acre-feet); April 1, 1955, combined storage 3,960,000 acre-feet. (c) Does not include John Martin Reservoir on the Arkansas River (capacity 655,000 acre-feet); April 1, 1955, storage 1,200 acre-feet; or Granby, Horsetooth, and Carter Lake on Colorado-Big Thompson project (combined usable capacity about 700,000 acre-feet); April 1, 1955, about 228,000 acre-feet. (d) Cedar Bluffs Reservoir only. (e) Does not include Fort Peck Reservoir (capacity 19,000,000 acre-feet); April 1, 1955, storage 9,326,000 acre-feet; or Flathead Lake (capacity 1,791,000 acre-feet); April 1, 1955, storage 710,000 acre-feet; or Hungry Horse Reservoir (capacity 3,500,000 acre-feet); April 1, 1955, storage 2,155,000 acre-feet. (f) Does not include Lake Mead (capacity 27,217,000 acre-feet); April 1, 1955, storage about 11,500,000 acre-feet. (g) Heart Butte and Dickinson Reservoirs. (h) W. C. Austin Reservoir (new in 1945). (j) Red Bluff Reservoir on Pecos River. Lake Travis and Buchanan Reservoir (combined capacity 2,844,000 acre-feet); April 1, 1955, storage 1,613,000 acre-feet. (k) Irrigation Reservoirs only. Does not include Roosevelt Lake (capacity 5,072,000 acre-feet); April 1, 1955, storage 749,000 acre-feet or Grand Coulee Equalizing (capacity 761,800 acre-feet), April 1, 1955 storage 452,000 acre-feet. (l) Does not include Boysen Dam (capacity 758,000 acre-feet), April 1, 1955, storage 269,000 acre-feet.

voir on the Little Colorado River stores less than 2,000 acre-feet, only 7 percent of its capacity, and with little prospects of any substantial improvement. Lake Mead stores less water now than at any time since initial filling was complete.

California.—Water conditions in California as of April 1, as reported by the State Division of Water Resources, are generally unsatisfactory and indicate that the water supply for 1955 will be much below average. However, critical conditions are anticipated only in localized areas where development of conservation storage and groundwater basins have not kept pace with growth. With the present high degree of integration of major hydro and steam electric plants throughout the State, there are no indications that the deficiencies in surface water supply will adversely affect power output.

There were no storms of consequence during March. From the standpoint of precipitation to date, this year appears to be the driest since 1947. If the near drouth conditions should continue through another season, as has happened in the past, water conditions would become acute in many areas.

The water content of the snow pack varies from 40 to 60 percent of average in the Cascade Mountains and Sierra Nevada. The snow pack is generally about the same as that for March 1, except at the lower elevations where considerable snowmelt occurred during March. The anticipated snowmelt season runoff, assuming normal precipitation during the April–June period, is expected to be less than that for any year since 1947, and the flow of the Kern River may be the lowest since 1934.

Major conservation reservoirs serving areas in California had in storage on April 1 about 44 percent of their total capacity which is approximately 5,800,000 acre-feet less than 1 year ago. The major portion of this decrease being in Lake Mead. Storage in intrastate reservoirs is about 72 percent of the 10-year average. As a result of the anticipated below average snowmelt runoff, it is expected that the heavy draft on the low storage reservoirs will deplete many reservoirs prior to the end of the irrigation season.

Subnormal runoff has provided inadequate replenishment to groundwater basins in California. Deficient precipitation during February and March resulted in preseason pumping in many areas and below average surface supplies will undoubtedly require above average pumping in many areas during the latter part of the 1955 irrigation season. As a result, the water levels in most major groundwater basins will be considerably lower at the end of the 1955 irrigation season than in the fall of 1954.

Colorado.—Summer discharge of all streams originating in the mountains of Colorado will be less than normal in 1955, but will exceed 1954 on all streams except the Rio Grande. The water supply in 1954 was near the lowest of record in practically all areas of the state. Because of low carryover in small irrigation reservoirs the statewide water supply outlook for 1955 is not much better than it was last year. The lack of storage will cancel the expected increase in streamflow over 1954. Users should be prepared to reduce their demands for water.

Forecasts of flow for the North and South Platte and Arkansas Rivers and their tributaries is for about 75 percent normal for the April–September 1955 period. On the Colorado River drainage forecasts range from nearly 90 percent of normal on the Upper Colorado, Yampa, and White Rivers to 65 to 70 percent on the San Juan River and its tributaries in southwestern Colorado. The water supply outlook is fair to good and much better than a year ago in the west slope.

Water available for irrigation in San Luis Valley along the Rio Grande will probably be less

Continued on page 51

THE THREE ZANJEROS of SALT RIVER VALLEY

by

HENRY F. UNGER, Salt River Power District, Phoenix, Arizona

A record, not soon to be surpassed, was racked up recently by a trio of zanjeros (ditch riders) of the Salt River Valley Water Users' Association. Together, Sam Hood, James Bolen and R. C. (Pete) Roberts have worked as zanjeros for a total of 105 continuous years. Hood, sporting 36 years of service followed closely by Bolen with 35 years of ditch-riding, retired at the end of December. Roberts retired at the end of January with 34 years of zanjero service behind him.

This trio of veteran zanjeros, so vital to the economy of the farmer and the Valley, has watched the Salt River Project thrive and grow. Together they have lifted thousands of headgates to release precious irrigation water into the ditches for farm needs. Together, after their long years of steady service, they still marvel at the changes in the Project and the Salt River Valley.

Highlights, according to the zanjeros, among the changes over the years were the disappearance of the Maricopa Canal in the early 30's, the happy changeover from wooden gate structures and the introduction of two-way radio into the zanjero's cars.

"I still recall all the splinters that I absorbed from those wooden gate structures," Roberts recalls.

Zanjero work, the trio will agree, was hard years ago when compared with today's activities. During the early years, they were on a 24 hours-a-day call. The three men recall 48-hour periods of steady work. "Pavements were often mud paths," Hood recalls, "and that meant stuck cars."

Although today a zanjero will have hundreds of customers because of the breakup of farmland into subdivisions as compared to 150 customers in 1920, the retiring zanjeros insist that each now is able to plan his division more accurately and the more rapid means of transportation has conquered many irrigation headaches.

105 YEARS of ZANJERO SERVICE—That's the record of the gentlemen in the inset. L. to r. James Bolen, Sam Hood, and R. C. (Pete) Roberts now enjoying retirement. *Photo courtesy Salt River Power District—Henry F. Unger.* Top photo shows typical irrigation on Salt River project. *Ben Glaha photo—Region 2.*

The trio agrees that the zanjero was a kind of unofficial policeman in years gone by.

"Before we were riding almost constantly in pickup trucks as we do today, we were seen around vital headgates and were stopped by strangers who asked travel directions," Bolen reports. "These people felt that because of our job we should know the whereabouts of people and streets and, believe me, we did," Bolen adds.

The zanjeros reminisce about their work, noting that no two days were alike. There were all types of customers to please, many of whom had no conception of what occurred when water was ordered and the headaches we had before it was delivered.

"I can still remember back in 1920, the white frame house that I lived in—in the middle of a wheat field," Roberts recalls. "On our front porch the U. S. Forest Service installed an old fashioned box telephone for use by the general public. Drinking water had to be hauled in—in 10 gallon cans and it cost 1¢ per gallon. A Water Users' pump was finally located on 24th Street and Osborn Road and water was then hauled from there. Water for the family wash was carried from the old Maricopa Canal which used to run back of the house."

Roberts recalled one incident typical of the life of the old-time zanjero. It seems that he had a Mexican who aided him in the irrigation of his field. One day the Mexican fell asleep and the area surrounding his home was flooded. The water was soon up to his front door and Roberts had no way to call the watermaster. Finally, the latter, by a stroke of good luck, appeared and cut the old Maricopa Canal to release the water. Along with the water went 200 chickens, stove wood and other articles.

"There were about 30 inches of water standing in the field with the house in the middle of this minor lake," Roberts remembers.

Hood jogs his memory and recalls the days before the invention of the Clausen Weir Stick when water was measured only at the head of the lateral and when water was delivered to the users by arbitration between the user and the zanjero.

The retiring zanjeros remember with a weary sigh the large area which they handled. "I still serviced an area covering 18 miles of laterals with one starting at 24th Street and the Grand Canal and ending at 17th Avenue and McDowell, when I retired," Roberts said. "Actually, my area covered about 12 square miles," he added.

To Sam Hood fell the task of handling a division 12 miles long and 3 miles wide around Mesa, while James Bolen kept busy with 18 miles of laterals in the Gilbert area.

Vividly remembered were the work days when the zanjeros had to change 36 gates in a 24-hour period. That meant many sore muscles. The zanjeros recall how some customers would call them at 2 a. m., requesting water. Often, these customers were farmers ready to milk cows and they felt that other people were also awake.

Despite the rigorous schedule maintained through their many years of rugged service with the Project, these men sport good health records.

Below, Water master using gage manufactured by the Salt River Valley Water Users Association. Center, Turning water from a main canal into lateral. Far right, Turning water from lateral into farm ditch. *All photos taken on Salt River Project by Ben Glaha, now of Region 2, in April 1938.*

Hood claimed no sick leave since 1925 while Roberts hadn't had an off-day since 1941. Bolen, though rarely missing from work, had been ill a little oftener.

Roberts who lives at 1217 E. Osborn with his two daughters (his wife died recently) came to Arizona from Carrollton, Illinois. He arrived on a Saturday and on the following Monday, November 1, 1920, he was working as a zanjero. Hood, born in Georgia, came to Phoenix in 1912 and worked for a short time for the Reclamation Service. In January 1918 he took on the duties of zanjero for the Association. He lives on a ranch northeast of Mesa and has 7 living children. Bolen, who lives at 102 W. Palo Verde, Gilbert, came to Phoenix from Sioux Rapids, Iowa, and hooked up with the Water Users' Association as a zanjero in December 1919. He is married and has four children.

Zanjeros R. C. Roberts, Sam Hood and James Bolen have seen the Salt River Valley prosper and they feel that they had an important share in its growth. But now that they have a chance to retire, the trio hopes to relax and fish and perhaps take on a part-time job to supplement their pension. After all, all three agree, you can't shut off immediately the full and busy life of a zanjero.

# # #

The San Diego Aqueduct

Continued from page 32

San Diego County and terminates at the San Vicente reservoir of the City of San Diego water system, some 71 miles distant.

The job is an outstanding example of the ability of Federal and State agencies to work together to accomplish a mutual objective. Through the cooperation of the San Diego County Water Authority, The Metropolitan Water District of Southern California, and the Department of the Navy, and because of the fact that the Congress has made full appropriation of the estimated cost, the Bureau of Reclamation was able to push the work forward expeditiously and to complete it with a resultant engineering and administrative cost that was well below the general average, and at a total cost within close proximity of the estimate.

We propose to follow up this article in an early issue of the *Era* with a detailed account of construction on the second barrel of the San Diego Aqueduct. Ed. ###

Lineweaver Appointed to Interior Committee

Goodrich W. Lineweaver resigned as Assistant to the Commissioner, effective February 15, to accept a post with the Senate Interior and Insular Affairs Committee. In the new assignment he will serve as an adviser on the Committee's professional staff on Reclamation and water resources.

Mr. Lineweaver had been connected with the Bureau of Reclamation in various capacities since 1939. He served as Executive Secretary of the Reclamation Repayment Commission in 1937–1939.

A farewell testimonial luncheon was held for Mr. Lineweaver at the National Press Club on the eve of his departure. Mrs. Lineweaver and more than 100 fellow-employees and friends were in attendance.

Water Stored in Western Reservoirs

(Operated by Bureau of Reclamation or Water Users except as noted)

Location	Project	Reservoir	Storage (in acre feet)		
			Active capacity	March 31, 1954	March 31, 1955
Region 1	Baker	Thief Valley	17, 400	17, 400	13, 100
	Bitter Root	Lake Como	34, 800	5, 800	6, 000
	Boise	Anderson Ranch	423, 200	216, 300	193, 500
		Arrowrock	286, 600	221, 300	216, 600
		Cascade	654, 100	113, 700	65, 100
		Deadwood	161, 900	89, 900	71, 600
		Lake Lowell	169, 000	150, 800	142, 000
	Burnt River	Unity	25, 200	15, 600	4, 400
	Columbia Basin	F. D. Roosevelt	5, 072, 000	2, 933, 000	749, 000
		Equalizing	761, 800	[1] −60, 600	452, 500
		Potholes	470, 000	58, 400	72, 600
	Deschutes	Crane Prairie	55, 300	54, 000	49, 000
		Wickiup	187, 300	199, 000	194, 000
	Hungry Horse	Hungry Horse	2, 982, 000	1, 500, 300	1, 708, 600
	Minidoka	American Falls	1, 700, 000	1, 697, 800	1, 705, 000
		Grassy Lake	15, 200	13, 000	12, 300
		Island Park	127, 200	132, 700	132, 600
		Jackson Lake	847, 000	401, 400	473, 800
		Lake Walcott	95, 200	65, 200	73, 200
	Ochoco	Ochoco	47, 500	47, 000	23, 200
	Okanogan	Conconully	13, 000	8, 900	6, 200
		Salmon Lake	10, 500	9, 800	10, 100
	Owyhee	Owyhee	715, 000	532, 000	209, 200
	Umatilla	Cold Springs	50, 000	50, 000	42, 300
		McKay	73, 800	43, 900	20, 200
	Vale	Agency Valley	60, 000	38, 800	27, 600
		Warm Springs	191, 000	139, 900	33, 700
	Yakima	Bumping Lake	33, 700	13, 600	19, 600
		Cle Elum	436, 900	256, 800	332, 100
		Kachess	239, 000	183, 100	206, 600
		Keechelus	157, 800	82, 600	109, 600
		Tieton	198, 000	122, 100	140, 700
Region 2	Central Valley	Keswick	20, 000	18, 200	17, 900
		Millerton Lake	427, 800	223, 900	214, 400
		Shasta	3, 998, 000	3, 314, 400	2, 914, 100
	Klamath	Clear Lake	513, 300	319, 100	235, 600
		Gerber	94, 300	73, 000	36, 800
		Upper Klamath Lake	524, 800	432, 600	408, 900
	Orland	East Park	50, 600	50, 200	34, 700
		Stony Gorge	50, 000	50, 600	26, 600
Region 3	Boulder Canyon	Lake Mead	27, 207, 000	15, 701, 000	11, 558, 000
	Davis Dam	Lake Mohave	1, 809, 800	1, 784, 600	1, 755, 000
	Parker Dam Power	Havasu Lake	688, 000	635, 800	630, 000
	Salt River	Bartlett	179, 500	84, 700	57, 000
		Horse Mesa	245, 100	244, 800	243, 000
		Horseshoe	142, 800	76, 500	1, 000
		Mormon Flat	57, 900	54, 500	56, 000
		Roosevelt	1, 381, 600	693, 500	401, 000
		Stewart Mountain	69, 800	58, 600	68, 000
Region 4	Eden	Big Sandy	38, 300	5, 400	9, 800
	Fruitgrowers Dam	Fruitgrowers	4, 500	3, 000	3, 100
	Humboldt	Rye Patch	190, 000	95, 900	10, 800
	Hyrum	Hyrum	15, 300	13, 800	12, 200
	Mancos	Jackson Gulch	9, 800	3, 200	3, 000
	Moon Lake	Midview	5, 800	5, 700	5, 700
		Moon Lake	35, 800	13, 500	11, 900
	Newlands	Lahontan	290, 900	270, 500	186, 800
		Lake Tahoe	732, 000	582, 000	360, 000
	Newton	Newton	5, 300	3, 200	2, 200
	Ogden River	Pineview	44, 200	8, 000	4, 900
	Pine River	Vallecito	126, 300	36, 300	58, 500
	Provo River	Deer Creek	149, 700	100, 400	81, 031
	Scofield	Scofield	65, 800	34, 800	11, 500
	Strawberry Valley	Strawberry Valley	270, 000	220, 200	175, 880
	Truckee Storage	Boca	40, 900	6, 500	794
	Uncompahgre	Taylor Park	106, 200	52, 500	54, 085
	Weber River	Echo	73, 900	36, 900	27, 500
Region 5	W. C. Austin	Altus	162, 000	15, 500	16, 200
	Balmorhea	Lower Parks	6, 500	6, 100	6, 200
	Carlsbad	Alamogordo	122, 100	34, 000	82, 600
		Avalon	6. 000	4, 800	2, 000
		McMillan	38, 700	0	28, 900
	Colorado River	Marshall Ford	1, 835, 300	669, 400	496, 600
	Rio Grande	Caballo	340, 900	28, 600	14, 300
		Elephant Butte	2, 185, 400	138, 600	139, 600
	San Luis Valley	Platoro	60, 000	0	0
	Tucumcari	Conchas [2]	465, 100	66, 700	43, 900
Region 6	Missouri River Basin	Angostura	92, 000	32, 700	48, 500
		Boysen	710, 000	382, 000	268, 700
		Canyon Ferry	1, 615, 000	413, 700	749, 300
		Dickinson	13, 500	5, 700	4, 300
		Fort Randall [2]	3, 900, 000	127, 300	1, 870, 900
		Heart Butte	218, 700	56, 200	56, 800
		Keyhole	130, 000	8, 600	15, 000
		Shadehill	300, 000	82, 700	77, 800
	Belle Fourche	Belle Fourche	185, 200	120, 400	68, 000
	Fort Peck	Fort Peck [2]	14, 877, 000	7, 605, 800	4, 573, 400

See footnotes at end of table.

Water Stored in Western Reservoirs—Continued

Location	Project	Reservoir	Storage (in acre feet)		
			Active capacity	March 31, 1954	March 31, 1955
Region 6—Continued	Milk River	Fresno	127,200	86,100	76,200
		Nelson	66,800	38,100	47,500
		Sherburne Lakes	66,100	[3]	19,900
	Rapid Valley	Deerfield	15,100	15,100	10,900
	Riverton	Bull Lake	152,000	69,300	62,200
		Pilot Butte	31,600	17,700	26,400
	Shoshone	Buffalo Bill	380,300	147,800	133,800
	Sun River	Gibson	105,000	77,500	69,000
		Pishkun	30,100	20,500	19,200
		Willow Creek	32,400	26,900	25,300
Region 7	Colorado-Big Thompson	Carter Lake	108,900	17,700	64,900
		Granby	465,600	298,700	82,000
		Green Mountain	146,900	47,100	34,900
		Horsetooth	141,800	114,000	8,300
		Shadow Mountain	1,800	1,600	1,400
	Missouri River Basin	Bonny	167,200	38,400	38,400
		Cedar Bluff	363,200	95,000	41,800
		Enders	66,000	33,700	35,000
		Harlan County [2]	752,800	56,400	91,900
		Harry Strunk Lake	85,600	29,100	30,200
		Swanson Lake	249,800	22,400	36,500
	Kendrick	Alcova	24,500	21,300	5,800
		Seminoe	957,000	180,700	257,100
	Mirage Flats	Box Butte	30,400	18,200	17,500
	North Platte	Guernsey	39,800	19,300	32,000
		Lake Alice	11,200	8,600	0
		Lake Minatare	59,200	31,200	14,100
		Pathfinder	1,010,900	866,200	476,000

[1] Minus active storage figure due to pumping from dead storage during the month.
[2] Corps of Engineers Reservoir.
[3] Not reported.

Water Supply

Continued from page 46

than in 1954. Forecasts range from 50 to 60 percent of normal. Snowmelt runoff will be insufficient to meet all demands.

Soil moisture conditions in both valley and mountain areas are poor in eastern Colorado and fair to good on the west slope.

IDAHO.—The water supply outlook for streams in northern Idaho is near normal for 1955. The southern half has a poor water supply in prospect except along the main stem of the Snake River. Significant increases in the snow pack occurred during March in the north, but very little change took place in the southern portion where the water shortage is most critical.

Furthermore, watershed soils are dry and will take up more than the usual amount of the snowmelt before runoff starts.

Critical water shortages are developing in irrigated areas served by the Big and Little Lost Rivers, the Big and Little Wood Rivers, Salmon Falls Creek, and the Owyhee River. Carryover storage and the snow pack are very low in respect to normal. The Boise and Payette Rivers have one of the lightest snow packs in years, but reservoir storage will provide adequate irrigation water for this year on those two rivers. Carryover storage next fall will not be adequate for 1956.

KANSAS.—With no water stored in John Martin and the Great Plains reservoirs in eastern Colorado, water available for irrigation along the Arkansas River in western Kansas will be much less than normal. Only rainfall of high proportions in the Arkansas Valley can improve the situation. Storage in Cedar Bluff Reservoir on the Kansas River watershed is now 94,000 acre-feet as compared to 185,000 acre-feet of irrigation storage capacity.

MONTANA.—The snow pack on the Rocky Mountains feeding the Upper Missouri and Upper Columbia Rivers in Montana is 20 percent of the average. Early runoff is expected on both rivers.

The April–September flow into Fort Peck reservoir on the Missouri River will be 3,756,000 acre-feet, or 77 percent average. The Yellowstone River should produce 1,714,000 acre-feet, or 85 percent average flow for April–September.

On the Columbia River drainage, the Flathead River at Columbia Falls, Montana is forecast to flow 5,152,000 acre-feet of water between April 1 and September 30, or 85 percent average. The April–September inflow to Hungry Horse Reservoir on the South Fork of the Flathead River is forecast to be 1,850,000 acre-feet, or 82 percent average. The Clark Fork River should produce approximately 11 million acre-feet of water at the Montana-Idaho boundary during April–September, equal to 81 percent average.

NEBRASKA.—Western Nebraska areas along the North Platte will be limited to sharing 75 percent normal runoff into Wyoming reservoirs on this stream. Shortages of irrigation water seem virtually certain. Adequate water supply will be available only if rainfall during the summer months is well above average. Storage in Kings-

Continued on page 3 of Cover

Hay Crushing

Continued from page 38

cate there is no difference in this loss between crushed and uncrushed hay.

The various crushing machines now available differ little in construction, operation and effectiveness.

VALUES YOU CAN EXPECT from crushing: Reducing the time the hay has to be left in the field to cure is the key to the benefits obtained by crushing.

Cuts weather damage. Reducing the field curing time by half will more than double your chance of getting the hay put up without damage.

Saves more hay. By preventing the loss of leaves and small stems which results from extra drying and handling after rains, you may save as much as 10 percent more hay.

Conserves feeding value. More carotene is saved by the relatively short exposure to sun and rain. Rapid curing means that you also save the protein that would otherwise be lost in shattered leaves. Color is also better.

Shortens the haying season. Faster curing means that men and equipment are not tied up so long in haying operations. Still more time and work are saved if you can avoid having to turn windrows to get them dried out.

Improves palatability. Crushing reduces the stems, especially the coarser ones, so that they are less harsh and brittle. This, together with the probable saving of leaves, make the hay more palatable.

Faster drying after rain or dew. Crushing puts the hay in better condition for rapid drying. After getting wet, it will still dry more quickly than uncrushed hay.

May be a part of any method of hay making:

Crushing is merely another operation in hay making, with the single purpose of speeding up field curing. After the hay is cured, it can be stored as long hay, baled in the field, or chopped with a field harvester, as you wish. The crusher can also be used in connection with a mow finisher to further shorten the field-curing time. ###

"GET ACQUAINTED" COPIES

If you have friends or associates who would be interested in the Reclamation Era, please send their names and addresses to the Bureau of Reclamation, Washington 25, D. C. We shall be glad to send them copies of back issues.

Don S. Campbell New Chief of Reclamation's Power Division

Don S. Campbell was appointed Chief of the Bureau of Reclamation's Power Division in Washington, D. C., by Secretary of the Interior Douglas McKay on April 11. Mr. Campbell has been regional supervisor of power in the Bureau's Boise, Idaho, office.

He was named regional power chief in Boise in January 1946 and has served in that capacity until coming to Washington to fill the vacancy left by Henry B. Taliaferro, who resigned in December 1954 to join the New York State Power Authority, Commissioner of Reclamation W. A. Dexheimer said.

Prior to joining the Bureau in 1946, Mr. Campbell was Special Assistant to the Chief Engineer of Bonneville Power Administration in Portland, Oregon. From 1942 to 1945, he was a Lieutenant and Lieutenant Commander in the United States Navy. From 1938 to 1942, he was with the Bonneville Power Administration in Oregon. From 1935 to 1938 he worked for the Corps of Engineers at Bonneville Dam. He worked for the Washington Water Power Company at Spokane, Washington, for eight years beginning in 1924, and subsequently was associated with the Department of Public Works, Washington State, beginning in 1933.

Born in Wisconsin, Mr. Campbell moved with his family to Washington State where he went through high school and the University of Washington. He graduated in 1923 with a B. S. degree in electrical engineering. #

Former Commissioner Page Dies

John C. Page, Commissioner of Reclamation from 1936 to 1943 passed away in Denver, Colorado, on March 23 after a long illness.

Mr. Page, well known in the field of engineering, served with the Bureau for 38 years until ill health forced his retirement. He began as a topographer in 1909 and advanced progressively in the various fields of engineering until he became Director of the Engineering Division in Washington and was named Commissioner in 1936. After his retirement, Mr. Page was retained by the Bureau as a full-time Engineering Consultant. He served in this capacity until 1947.

Secretary McKay in his condolence message to Mrs. Page said: "Mr. Page left a reputation of integrity, ability and accomplishment as Commissioner of Reclamation. This reputation, built over a period of 38 years in the Bureau as a career engineer, endures today within the Department, the Engineering Profession, and among friends of Reclamation throughout the West."

Reclamation Commissioner W. A. Dexheimer said that Mr. Page was greatly admired by his employees, by advocates of water and land resources development, and by members of the Congress with whom he worked on Reclamation matters.

Mr. Page was born in Syracuse, Nebraska. He graduated from the University of Nebraska with a B. A. degree in civil engineering and continued studies later at Cornell University.

He served as a member of the Water Resources Committee of the National Resources Committee and as a member of the President's Great Plains Drought Committee. In 1941, he received the honorary degree of Doctor of Engineering from his alma mater, the University of Nebraska. He was a member of Sigma Tau and an honorary member of the American Society of Civil Engineers. In 1950, he was awarded the Department of the Interior gold medal for distinguished service.

The Editor's Column

The following facts have been gleaned from the United States Department of Agriculture's Statistical Summary, dated February 18. We hope that you find them helpful.

Citrus Crops

The 1954–55 orange crop is estimated at 133.7 million boxes, 6 percent above the previous crop. Utilization to February 1 is smaller than to the same date a year ago, so that 10.5 million boxes more were available February 1 than a year earlier.

The grapefruit crop is forecast at 43.6 million boxes—10 percent less than last season and 13

percent below average. Utilization to February 1 totaled about 17.5 million boxes compared with 19 million boxes to February 1, 1954.

The California lemon crop is placed at 14.6 million boxes—9 percent below last season but 17 percent above average.

Vegetables

Vegetable crops suffered considerable cold damage during January. Prospective total fresh market supplies of the 20 commercial vegetables produced in the winter season are now about 7 percent below last year. Wet soils and below-normal temperatures also slowed planting and development of spring vegetables in most early sections.

Production Comparisons

	January 1954	January 1955
Milk (bil. lb.)	9. 2	9. 1
Eggs (bil.)	5. 5	5. 8
Beef (dr. wt., mil. lb.)	[1] 9, 368	[1] 9, 681
Pork & lard (mil. lb.)	[1] 9, 776	[1] 9, 876
Lamb & mutton (dr. wt., mil. lb.)	[1] 644	[1] 645
All meats (dr. wt., mil. lb.)	[1] 20, 669	[1] 21, 132

[1] January–December under Federal inspection.

Nonfarm Indexes of Interest to Agriculture

Index	Base period	Dec. 1953	Nov. 1954	Dec. 1954
Wholesale prices of food	1947–49=100	103	103	101
Retail prices of food	1947–49=100	112	111	110
Weekly factory earnings	1947–49=100	147	143	144

Farmers Plan to Buy Fewer Chicks

Farmers plan to buy 18 percent fewer chicks this year than they bought last year. Some difference between their February plans and their actual purchases is to be expected depending largely on egg and feed prices during the coming hatching season. All parts of the country plan decreases this year.

Potato Stocks Smaller Than Last Year

Stocks of merchantable potatoes on January 1, 1955, are estimated at 118 million bushels—7.9 percent less than a year earlier. These stocks are held by growers and dealers in or near producing areas and include all potatoes available for sale at any price for table stock, seed, livestock feed, starch, and other processing. The estimates do not include potatoes saved for food, seed, and feed on farms where grown and expected losses for the entire season through shrinkage, decay, and waste. In Maine, sales of 1954 crop potatoes to starch factories are expected to be quite large chiefly because of poor quality and small size. Of the 8 million bushels sold before January 1 from the 1954 Maine crop, 22 percent went to starch factories, compared with 17 percent of total sales of the 1953 crop to January 1, 1954.

Grain Stocks in All Positions January 1, 1955

	Million Bushels	
Wheat	1, 460	Nearly a tenth larger than on January 1, 1954, the previous January record. Farm stocks smallest since 1941; off-farm stocks are a record for the date.
Rye	25. 4	Largest January 1 stocks in 10 years; 18 percent above January 1954. About 35 percent is stored on farms.
Corn	2, 799	Largest January 1 stocks on record; 4 percent more than January 1954 stocks. Farm stocks a little above average but off-farm position is much larger than any previous January.
Oats	1, 016	Over a fifth larger than a year ago.
Barley	284	Largest of record; 59 percent larger than on January 1, 1954.
Sorghum grain	189	Nearly 2½ times as large as a year ago and exceeded only on January 1, 1951.
Soybeans	261	Largest January 1 stocks of record; 37 percent larger than a year earlier and 15 percent larger than the previous high in January 1951. Most of the increase is in farm stocks.
Flaxseed	31. 4	A tenth smaller than stocks held a year earlier but a sixth larger than January 1, 1953 stocks. Farm stocks made up a little more than half of the total compared with about a third usually.

January 1 stocks add up to records on this date for the tonnage of feed grains, for reserves of food grains, and by a large margin for the total of the six grains in storage—over 151 million tons.

LETTERS

A Word From Egypt

Dear Sirs: To our friends in America we offer our thanks as well as our deep appreciation for all their useful advices and valuable services and to them, in particular, we extend our best wishes assuring them that their generous help which no other country has ever offered to any other country friend, is heartily appreciated and their feeling is heartily reciprocated by us.

Your Government has offered a great deal through financial and technical aids and your magazine, the Reclamation Era, well makes it possible for my people to be au-courant with the latest agricultural developments.

We are looking forward to the next issue.

Cordially yours,

(Sgd.) RIAD SHARONI,
Manager, Farm & Orchard Service,
Ramleh-Egypt.

Finds ERA Educational

Dear Sirs: I received a lot of good knowledge from the magazine The Reclamation Era. I would like to see articles about Southern Calif. water situation in mountains and desert; also about soil conservation problem. This is the best educational magazine our Government has put out to read and learn. Thank you.

(Sgd.) E. M. KAESTER,
1135-W-105th St.
Los Angeles 44, Calif.

We will do our best to oblige. Ed.

"Weed Warning" Helpful

Dear Sirs:

I have received my copy of the February 1955, issue of *Reclamation Era*. In it is an article, "Weed Warning", written by John T. Maletic and illustrated by David Cunningham. I am wondering if it would be possible to obtain one or two copies of reprints of this article, or copies of the February issue containing it.

Irrigation in Kansas is rapidly increasing. In some places, there is a very serious weed problem on land that has been under irrigation for several years. Some areas are now being converted to irrigation farming without much thought being given to weed problems. In some of these locations, perennial weeds, such as field bindweed and Johnson grass, are present in small infestations which can be controlled if given the proper attention soon. Other areas are not infested yet and we hope to impress on the farmers operating this land the importance of preventing the introduction of the seeds of the important noxious weeds. The article, "Weed Warning", presents the problem in a way that is ideally adapted to our use in meetings we propose to hold with irrigation farmers.

I shall appreciate any assistance you can give in supplying copies of this article or suggestions as to where I might obtain them.

Yours truly,

(Sgd.) VERNON W. WOESTEMEYER
State Weed Supervisor,
Topeka, Kans.

We were glad to assist.—Ed.

DO YOU KNOW . . .

TALL PIPE STORY The longest single irrigation pipe we've heard about—more than one and one-half miles of two-inch plastic pipe—was recently manufactured by the Prima Pipe Company of Scottsbluff, Nebraska, for use on a Texas irrigation project.

Original plans called for making the pipe two miles long, but the truck used to carry it could haul only 8,880 feet.

100-TON RUBBER BAG If present plans go through, India will soon boast of a 12-million gallon reservoir neatly held in a rubber bag.

After more than two years of experimentation, the Sunderland and South Shields Water Company have accepted a plan worked out by the Dunlop Rubber Company for lining a reservoir with rubber.

Nearly one ton of adhesive will be used to fix some 16,000 square yards of one-quarter-inch-thick high quality rubber to the reservoir. The rubber bag will weigh 100 tons.

CANALS GO UNDERGROUND For the past quarter century a practice has been in effect in the Modesto and Turlock Irrigation Districts of California which is virtually unknown in agricultural or engineering circles more than 100 miles away.

This is the manufacture and installation in a single operation in the field of irrigation pipes made by pouring concrete over forms placed in the ditches.

Technically this is known as an unreinforced monolithically constructed concrete pipe.

As soon as the concrete hardens and the forms are removed the pipeline may be covered and is ready for use.

OKLAHOMA now is irrigating a total of 60,700 acres from surface water and 47,600 acres by ground water, a preliminary estimate by the Arkansas-White-Red interbasin council indicates. But there are more than a million acres of land suitable for irrigation, for which the agency estimates future impounded water could supply all but 223,500 acres, which only ground water sources could aid.

MOUNTING INTEREST IN WATERSHED PROTECTION. Continued mounting interest in upstream watershed protection is apparent in the many applications by local groups for aid in the cooperative projects authorized by the Watershed Protection and Flood Prevention Act signed last August by President Eisenhower.

Arrangements are being made, at both the federal and state levels, to expedite and simplify procedures for getting the watershed improvement job started. Governors of about a fourth of the states have already designated agencies to handle applications. Formal application blanks for use by local watershed groups are being prepared and will soon be available in all states. In the meantime, local organizations may obtain information on how to initiate watershed programs from the state headquarters of the Soil Conservation Service and the Agricultural Extension Service. We are indebted to the Irrigation Engineering and Maintenance Magazine for the foregoing.

PALISADES PROJECT, Idaho, was singled out for a National Award for its year-round Fire Prevention Program and observance work during Fire Prevention Week, October 3–9, 1954.

Hub of the Fire Safety Program at Palisades Project is the 35 member Volunteer Fire Department which is on duty at all times. The Department holds periodical fire drills, distributes fire prevention literature, schedules the showing of movie film on fire prevention measures to all camp residents and department members alike and other fire prevention activities.

Highlights of the Fire Prevention organizational activities during the year were the agreements entered into with the Palisades Contractors (the prime construction contractor), the Villages of Irwin and Swan Valley, Idaho, in furthering the Fire Protection measures in the immediate vicinity of the Bureau town. Fire prevention Week activities were kicked off with a parade through the townsite, consisting of local floats, Boy Scouts, 4–H girls and other contestants, all portraying fire protection methods in observance of Fire Protection Week. The departments building inspection schedule included all office buildings, storage buildings, recreational buildings, and individual residential units for apparent fire hazards. Promptly after, organizational work was under way to correct these hazards. Demonstrations in the use of various fire extinguishers were held at the Irwin Public School grounds with students of the school participating in the use of suppressing different types of fires. A fire drill was held by the faculty of the school with members of the Volunteer Department observing and offering methods of improvements in the drill. Inspection of all school facilities and buildings for fire hazards was conducted by a joint group of school officials and by members of the Department.

Results of the 1954 Fire Prevention Week contest sponsored by the Fire Protection Association, Boston, Massachusetts, cited award of special recognition to the Palisades Volunteer Fire Department, Bureau of Reclamation, United States Department of the Interior, "for an outstanding and effective Fire Prevention Program by a Government facility."

MAJOR RECENT CONTRACT AWARDS

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DC-4236	Parker-Davis, Ariz.-Calif.-Nev.	Mar. 2	Additions to Gila substation	Powerline Construction Co., Nashville, Tenn.	$134,563
DC-4281	Yakima, Wash	Jan. 5	Earthwork, canal lining, and structures for Main canal, station 766+50 to 1300+00, utilizing monolithic concrete in all siphons.	Otis Williams & Co., Kennewick, Wash.	526,732
DC-4292	Missouri River Basin, Mont.	Feb. 2	Reconstructing and graveling 31.8 miles of county road for Tiber Reservoir area.	Edwin C. Powell, Great Falls, Mont.	184,557
DC-4302	Missouri River Basin, Nebr.	Feb. 1	Construction of 32.5 miles of Gavins Point-Belden 115-kilovolt transmission line.	Hoak Construction Co., West Des Moines, Iowa.	266,786
DC-4306	do	Feb. 4	Earthwork and structures for Franklin Canal, station 2178+20 to end, and Franklin laterals, second section.	Bushman Construction, St. Joseph, Mo.	454,438
DC-4310	Columbia Basin, Wash	Feb. 25	Earthwork, pipelines, concrete lining, and structures for Potholes East canal laterals, sublaterals, and wasteways, block 19.	Cherf Bros., Inc., and Sandkay Contractors, Inc., Ephrata, Wash.	1,297,368
DC-4311	Yakima, Wash	Feb. 24	Earthwork, canal lining, and structures for Main canal, station 114+70 to 766+50, and lateral turnout deliveries, station 41+18.77 to 766+50, utilizing monolithic concrete in siphons.	Lewis Hopkins Co., Pasco, Wash.	773,313
DC-4312	Columbia Basin, Wash	Feb. 25	Earthwork and structures for lateral W20, station 428+50 to 792+30, West canal laterals, block 89.	H. C. Werner, George W. Lewis, and Tauf Charneski, Eugene, Oreg.	366,043
DS-4316	Cachuma, Calif	Jan. 24	39,000 barrels of bulk portland cement for Tecolote tunnel	Permanente Cement Co., Oakland, Calif.	156,390
DC-4323	Yakima, Wash	Feb. 17	Construction of Amon pumping plant, wasteway, siphon, and appurtenant works, utilizing precast-concrete pressure pipe in 78-inch diameter portion of Amon siphon.	Cherf Bros., Inc., and Sandkay Contractors, Inc., Ephrata, Wash.	292,216
DC-4325	Missouri River Basin, N. Dak.-S. Dak.	Mar. 10	Construction of 80.5 miles of Edgeley-Groton 115-kilovolt transmission line.	Schurr and Finlay, Inc., Yorba Linda, Calif.	535,195
DC-4329	Missouri River Basin, Wyo.-Nebr.	Mar. 3	Construction of 201.5 miles of Alcova-Gering and 5.6 miles of Lingle tap 115-kilovolt transmission lines.	Malcolm W. Larson Contracting Co., Denver, Colo.	1,493,268
DS-4339	Missouri River Basin, Wyo.	Mar. 2	Steel penstock, outlet pipes, surge tank, and surge tank lighting system for Glendo Dam.	Pittsburgh Des Moines Steel Co., Des Moines, Iowa.	466,626
DC-4342	Columbia Basin, Wash	Mar. 16	Earthwork and structures for laterals, sublaterals, and wasteways for east part of block 14; and sublateral PE38.9E8, block 13, Potholes East Canal laterals.	Pfeiffer and Pontius, Othello, Wash.	235,181
DC-4349	Hungry Horse, Mont	Mar. 30	River channel improvement and bank protection at Hungry Horse Dam.	Long Construction Co., Inc., Billings, Mont.	154,933
DS-4350	Missouri River Basin, N. Dak.	Mar. 24	One 25,000 kilovolt-ampere synchronous condenser with starting and control equipment for Fargo substation.	Allis-Chalmers Mfg. Co., Denver, Colo.	270,000
100S-202	Minidoka, Idaho	Jan. 12	Nineteen 150-kilovolt-ampere, twelve 100-kilovolt-ampere, ten 75-kilovolt-ampere, three 50-kilovolt-ampere, nine 37½-kilovolt-ampere, and nine 25-kilovolt-ampere distribution transformers for distributions substations, group 3.	R. E. Uptegraff Mfg. Co., Scottdale, Pa.	86,022
100C-209	do		Construction of concrete structures to replace temporary structures for group 1 laterals.	Leland Saxton, Boise, Idaho	39,554
100C-210	do	Mar. 18	Drilling and casing 16 water-supply wells. group 7, schedules 2 and 4.	Ralph C. Denton Drilling Co., Murtaugh, Idaho.	48,105
100C-211	Columbia Basin, Wash	Mar. 15	Construction of earthwork for drain W645, station 1158+21.15C to 900+00C, West canal main drains.	Carl Hohner, Spokane, Wash.	43,970
600C-155	Missouri River Basin, N. Dak.	Mar. 4	Construction of pumping plants, laterals, and drains for areas 18 to 37 near Heart Butte Dam, schedules 1 and 2.	McCormick-Erling Co., Bismarck, N. Dak.	109,860
600S-156	do	Mar. 7	25 horizontal, centrifugal-type pumping units; 1 mixed flow or propeller-type pumping unit; and 13 portable priming pumping units for Heart Butte pumping plants.	Berkeley Pump Co., Berkeley, Calif.	44,811

WORK CURRENTLY SCHEDULED THROUGH JUNE 1955*

Project	Description of work or material
Central Valley, Calif.	Constructing 12.5 miles of reinforced concrete pipe from 12 to 45 inches in diameter, 2 small low-head pumping plants, 2 small reservoirs, valves, water meters, and electrical controls. Southern San Joaquin Municipal Utility District, unit 1 extensions, near Delano.
Colorado-Big Thompson, Colo.	Constructing 69/24.19-kilovolt Granby Substation will include grading and fencing the site, constructing foundations and a small service building, furnishing and erecting steel structures, and installing electrical equipment, major items of which will be Government-furnished. Near Granby.
Do	Constructing 3,200 feet of 66-inch diameter HC-50 precast concrete pipe siphon with Type R joints. South Platte Supply Canal, near Firestone.
Columbia Basin, Wash.	Constructing 26 miles of unlined laterals with bottom widths of 20 to 2 feet; about 1 mile of 15- to 60-inch pipelines and 3 pumping plants with discharge lines. Block 47, near Othello.
Do	Constructing about 24.3 miles concrete-lined laterals with bottom widths from 5 to 2 feet; 9 miles of unlined wasteways and drains with bottom widths from 5 to 2 feet; 5.7 miles of 15- to 48-inch precast concrete pipelines; two 10.2- and 10-cfs capacity outdoor pumping plants with reinforced concrete sump structures. Block 89, East Part, W18-A, about seven miles south of Ephrata.
Do	Constructing 6.2 miles of concrete-lined laterals with bottom widths from 3 to 2 feet; 5.1 miles of unlined wasteways and drains with bottom widths from 5 to 2 feet; and 1.6 miles of precast concrete and corrugated metal pipe in canals, wasteways and drains, 15 to 36 inches in diameter. Block 89, North Portion, about 8 miles south of Ephrata.
Davis Dam, Ariz.	Constructing the 115-kilovolt Nogales Substation will include fencing the site, constructing foundations and a small service building, furnishing and erecting steel structures, installing electrical equipment, major items of which will be Government-furnished. Near Nogales.
Do	Constructing major additions to the switchyard for Wellton-Mohawk Pumping Plant No. 2 will include constructing foundations, erecting Government-furnished steel structures (transferred from Gila Substation), erecting new steel for alterations to existing structures, and installing electrical equipment of 161, 34.5, and 4.16 kilovolt, major items of which will be Government-furnished. Near Wellton.
Middle Rio Grande, N. Mex.	Drilling grout holes through concrete core wall and grouting left abutment and foundations at El Vado Dam. Near El Vado.
Do	Clearing and cleaning about 46.3 miles of drains and constructing 5.3 miles of new open drains in the Los Lunas, Bernalillo, San Antonio, and Albuquerque areas.
Minidoka, Idaho	Earthwork and structures for about 45 miles of unlined laterals and waterways varying in bottom width from 8 to 2 feet; and 5 relift pumping plants with discharge lines; North Side Pumping Division, Unit A. About 16 miles southwest of Rupert.
Do	Completing contract for 20 water supply wells including construction of pumping substations and installation of pumping units. North Side Pumping Division, near Rupert.
Do	Constructing about 20 miles of unlined laterals. North Side Pumping Division, near Rupert.

*Subject to change.

Project	Description of work or material
Minidoka, Idaho	Drilling, casing, and testing twenty-one 16-, 20-, and 24-inch water supply wells with minimum depths to be drilled varying from 270 to 350 feet. North Side Pumping Division, near Paul.
Do	Constructing a 2-bedroom frame residence at Jackson Lake Dam. Near Moran.
Do	One power transformer, 3-phase, 60-cycle, outdoor, 15,000-kva, 132,000- to 34,500-volt, with tank-mounted 34,500-volt lightning arresters and 1 power transformer, 3-phase, 60-cycle, outdoor, 2,500/3,125-kva, 33,000- to 4,160-volt, with 2 sets of tank-mounted lightning arresters. For Heyburn Substation.
Missouri River Basin, Kans.	Constructing about 9 miles of 635-cfs capacity earth section, Courtland Canal, Fourth Section, and about 8 miles of laterals, including one 10.5-foot monolithic siphon about 800 feet long, about 3.5 miles south of Webber.
Missouri River Basin, Mont.	Constructing a 7-foot-diameter horseshoe tunnel about 2.6 miles long about 15 miles east of Helena, adjacent to Canyon Ferry Dam.
Do	Two vertical-shaft, hydraulic-turbine-driven, centrifugal-type pumping units, each with a capacity of 150 cfs at a total head of 145 feet (design head on turbine 120 feet), for Helena Valley Pumping Plant.
Missouri River Basin, Nebr.	Constructing 22 miles of Sargent laterals varying in bottom width from 6 to 3 feet.
Missouri River Basin, N. Dak.	Constructing the 230/115/69/41.8/12.5-kv Fargo Substation will include constructing foundations and a concrete block service and control building; furnishing and erecting steel structures and installing electrical equipment, major items of which will be Government-furnished. Near Fargo.
Do	Constructing the 69/12.47-kv Ralston Substation, will include grading and fencing the site, constructing foundations and a small service building, furnishing and erecting steel structures, and installing electrical equipment, major items of which will be Government-furnished. Near Ralston.
Owyhee, Oreg	Four horizontal, motor-driven, centrifugal-type, pumping units, 2 units each with a capacity of 40 cfs, 1 unit with a capacity of 30 cfs, and 1 unit with a capacity of 20 cfs, all at a total head of 120 feet for Ontario-Nyssa Pumping Plant.
Palisades, Idaho	Constructing about 57 miles of 115-kv wood-pole, H-frame, transmission line from the Palisades Switchyard to the Goshen Substation of the Utah Power & Light Co. All materials to be furnished by the contractor. From Palisades to Goshen, Idaho.
Do	Earthwork, structures, and surfacing for 7 miles of Forest Service Road. Near Alpine, Wyo.
Do	Constructing base course and bituminous surfacing for 20 miles of relocated Idaho and Wyoming highways (U. S. Nos. 26 and 89). Near Palisades Dam, Idaho, and Alpine, Wyo.
Rogue River, Oreg.	Rehabilitating Fishlake and Four-Mile Dams, Medford and Rogue River Valley Irrigation District.
Solano, Calif	Earthwork, structures, and surfacing for 5 miles of California State Highway No. 102. Near Winters.
Weber Basin, Utah.	Constructing concrete Stoddard Diversion Dam and a section of the Gateway Canal will include installing four 25- by 7.5-foot radial gates and constructing earth embankments, reinforced concrete trashrack, canal headgate structures, settling basin and fish bypass structure and 4,700 feet of canal. Near Morgan.
Do	Enlarging Pineview Dam and modifying spillway; relocating outlet works control house; installing portions of penstock; replacing existing wood-stave pipe with concrete pipe; modification to water supply system; and relocating 3 miles of highway. Near Ogden.
Do	Constructing a 35-foot-high test section for Willard Bay dike, containing 160,000 cubic yards of embankment material. Near Ogden.
Do	Two 12- by 22-foot spillway radial gates for Pineview Dam.
Yakima, Wash	Constructing Highlands Feeder Canal and adjacent laterals, an open canal with maximum capacity of 128 cfs; and Badger East lateral and Badger West lateral. About 10 miles west of Kennewick.
Do	Two 12-foot diameter fish screens with motor drivers and 8 additional motor drivers and parts for modernizing existing screens. Estimated weight of fish screens: 13,200 pounds; drivers: 7,200 pounds. For Chandler Canal enlargement.

Water Supply

Continued from page 51

ley and Sutherland Reservoirs is 90 percent of average for April 1, enough to meet normal requirements for the Tri-County irrigated area. Soils in irrigated areas are dry and streamflow is below average.

NEVADA.—Snow stored water ranges from near normal in a small part of eastern Nevada to poor in the remainder of the State. Reports on streamflow show that winter flow was below normal for all streams. Ground water levels in most valleys are the lowest since records were started. Storage in irrigation reservoirs on April 1 was 44 percent of capacity and only 67 percent of the 1943–52 ten-year average. Water supply will be below normal in all parts of the State.

The Humboldt River at Palisades is forecast to flow only 17 percent of normal. Streamflow from the east central portion of the Sierras will range from 50 to 70 percent of normal.

Snow cover in the Spring Mountains in southern Nevada is 67 percent normal.

NEW MEXICO.—The water supply outlook along the Rio Grande in New Mexico is the poorest in recent years. Streamflow is expected to be even less than a year ago. Streamflow and water in storage together will supply only a small fraction of the usual water demand. Most of the water supply will have to come from underground sources. Storage in El Vado, Elephant Butte, and Caballo Reservoirs is about the same as a year ago, totaling approximately 160,000 acre-feet. Soils in all irrigated areas are dry and current streamflow is much below average.

The outlook for the irrigated area near Carlsbad is good. The flood on the Pecos River last fall filled these reservoirs. Storage is now twice the 10-year average and three times that of April 1, 1954.

Since storage in Conchas Reservoir is below normal and slightly below a year ago there will be a shortage of water for the Tucumcari project. Inflow from snowmelt will be negligible.

NORTH DAKOTA.—The water supply to irrigated areas along the Missouri River near Williston is good. Storage in Heart Butte and Dickinson Reservoirs is now standing at 82 percent of capacity. Recent snows have improved soil moisture conditions in this general area.

OKLAHOMA.—Storage in W. C. Austin Reservoir is about 12 percent of capacity and near one-half of average. The water supply outlook is poor.

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The Reclamation Era

August 1955

IN THIS ISSUE:

The Sun, the Weather . . . and You

Triple Benefits of a Wildlife Area

Official Publication of the Bureau of Reclamation

The Reclamation Era

AUGUST 1955 Volume 41, No. 3

In this issue . . .

DESIGN AND ILLUSTRATIONS by Drafting and Graphics Branch
Bureau of Reclamation, Washington, D. C.

J. J. McCARTHY, Editor
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* * *

30 Years Ago in the Era

There can be no doubt about the successful outcome of the Federal experiments in reclamation by irrigation if the experience now gained be applied to existing and coming projects. It is of the greatest importance to the stability of the country that the great work of reclamation and home making on the land continue. We must maintain the equilibrium between the urban and rural life to perpetuate and continue that splendid American institution—the farm home, the anchor of the Republic in every hour of stress and storm and strife.

From a speech by the late Hon. Charles L. McNary of Oregon, United States Senate

THE SUN, THE WEATHER

by DR. WALTER ORR ROBERTS, Director, High Altitude Observatory, Boulder, Colo.

In the next 10 years, perhaps sooner, we may see information about changes on the sun become as important to the weather forecaster as information about temperature, humidity and atmospheric pressure in the earth's atmosphere is today. Furthermore, if recent discoveries about sun-weather relationships fulfill the promise they seem to hold, this information will make possible forecasts of weather trends months and years in advance.

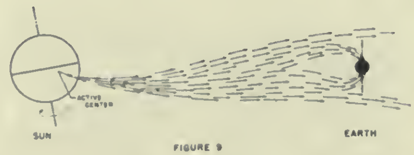
The potential benefits are enormous. Changes in our lives brought about by useful long range predictions of weather would range from the way we plan summer vacations to the heating or air-conditioning equipment we have in our homes. Dry land farmers could, for the first time, plan crops and capital outlay around knowledge of expected precipitation trends. Such knowledge would greatly affect, for the better, the problems of crop supports and surpluses that plague agriculture today.

For the irrigator, water user's organizations could for years in advance make plans for storage and release of water, dispelling the specter of empty reservoirs during a succession of dry years. Using such forecasts, irrigation farmers could plan their crops to account for expected temperature and subsoil moisture conditions. The happy coincidence of first large deliveries of Colorado-Big Thompson project water during the dry years of 1953 and 1954 might well be, for similar reclamation projects in the future, a *planned* coincidence, with programs accelerated to meet developing drouth needs.

EXPLOSION OF HYDROGEN GAS ON SURFACE OF THE SUN.

Admittedly I am one of a minority of solar scientists and meteorologists who believe strongly that the sun may play a key role in terrestrial weather. Against this view, the majority can

Diagram below illustrates how particles of hydrogen are attracted to earth's north and south poles after being ejected violently from so-called "active" centers on the sun (scale greatly exaggerated). Right diagram shows path of "polar" jet stream in northern hemisphere; a southern equivalent also exists.



point out that changes in visible light from the sun and fluctuations in the size and number of sunspots do not have any usable relationship to weather. These possibilities have been exhaustively explored without result.

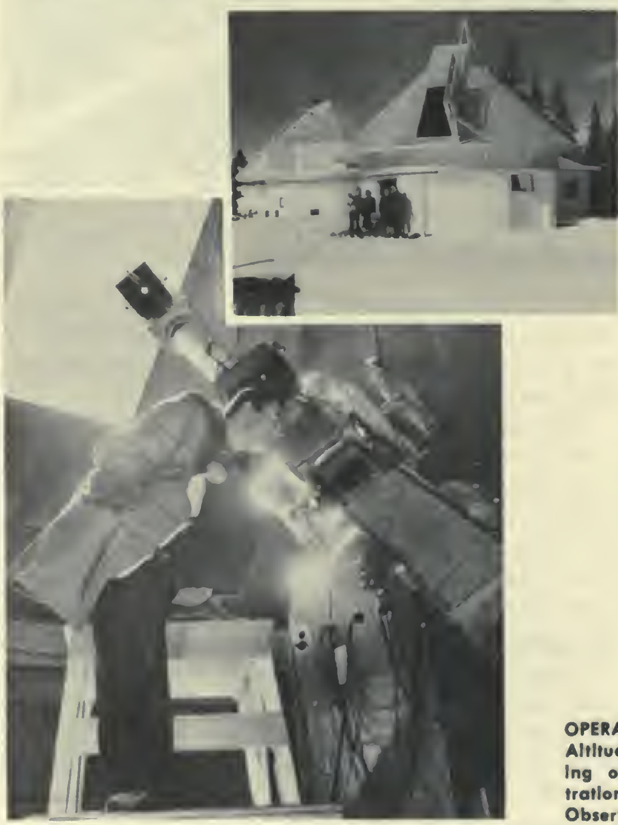
On the other hand, it is my opinion that powerful evidence already exists for a connection between the weather and certain types of "invisible" radiation from the sun, radiation that is absorbed high in the earth's atmosphere and is not visible at the earth's surface.

A paper by myself and Jean-Claude Pecker of the Meudon Observatory in France, published in the March 1955 *Journal of Geophysical Research*, shows how the interaction of magnetic fields in the sun's atmosphere may be responsible for variations in beams of hydrogen particles that shoot out from the sun and cause disturbances in the earth's magnetic field. As an example of how powerful these effects can be, the great magnetic storm of Easter Sunday, 1940, cut off radio communication between the United States and Europe for many hours, disrupted teletype and wirephoto circuits, and interrupted the transmission of electrical power by causing overloading currents that blew circuit fuses.

Could these same beams of hydrogen particles, or corpuscles, be causing similar, significant variations in weather? Work by R. Shapiro of Air Force Cambridge Research Center shows that when the intensity of these corpuscles received at the earth abruptly increases, as indicated by changes in the earth's magnetic field, so do abrupt changes occur in the earth's atmospheric pressure and the pattern of atmospheric flow. Similarly, H. A. Craig of the same laboratory has shown a relationship between changes in barometric pressure and beams of corpuscles reaching the earth's atmosphere. Just such changes as these are known to initiate weather changes.

Working with another type of radiation cut off high above the earth's surface, C. E. Palmer of the Oahu Research Center, University of California at Los Angeles, has shown that the development of

Continued on page 79



OPERATION RESEARCH is conducted from two observation domes of the High Altitude Observatory station at Climax, Colo. Left, Dr. Roberts checking optical adjustment of the Observatory's "Coronagraph." All illustrations except "polar" jet stream diagram courtesy of High Altitude Observatory. ***Latter supplied by Capt. B. C. Frost, Shell Aviation News.***

At right, Mr. Malm instructing his sons on starting irrigation tubes. Far right, Professor A. L. Clapp, Kansas State College illustrates "in-row" spacing of corn under irrigation. Lower right, Malm family looking over S. C. S. map of development farm. *Top photos by Kansas State College. Lower photo by Peterson, Bureau of Reclamation.*

KANSAS' IRRIGATION REPORT

by **RUSSELL L. HERPICH, Extension Irrigation Engineer, Kansas State College**

Is irrigation a profitable practice in the marginal rainfall areas of Kansas (those areas where the average annual precipitation exceeds 20 inches)? Can a small acreage of irrigated crops stabilize the operations and annual income of a farm unit which also includes 200–400 acres of nonirrigated crops?

The Kansas Irrigation Development farm program was designed to provide answers to these and many other related questions on irrigation. The selection and operation of development farms is a cooperative venture involving participation of a local farmer and the Kansas Technical Committee for Irrigation Development. Representatives from Federal, State and local agencies including Kansas State College, Soil Conservation Service, Kansas State Board of Agriculture, Kansas State Agricultural Stabilization and Conservation Committee, Kansas Farmer's Home Administration, Bureau of Reclamation and the Federal Extension Service are on this committee. Farm selections are made in areas in Kansas where irrigation storage water will shortly be impounded in large multiple-purpose reservoirs.

The cooperative nature of this program can best be explained by stating that the farmer cooperates by furnishing the land and stands most of the operational costs of crop production. The Technical Committee supplies the irrigation, agronomic, engineering, fertility, and management know-how where needed.

I represent the technical committee in all of the operational workings with the cooperating farmer. I consult regularly with various representatives of the cooperating agencies in order to obtain technical information that can be profitably applied on each or all of the farms operated under the program. The technical information thus obtained is relayed to the farm where it is discussed with the cooperator. At this time, we mutually agreed to either apply the new information or to postpone its use until a later date.

During 1954, four farms were cooperatively operated under this program. The Kanopolis Area Farm is located in the valley of the Smoky Hill

River, about 3 miles northeast of Lindsborg, Kans. It is operated by the Harold A. Malm family. The Cedar Bluffs Area Farm is located about 7 miles east of Cedar Bluff Reservoir on the table lands of the Smoky Hill River Valley. This farm is operated by the A. Raymond Kutina family. The Kansas Bostwick Area Farm is located on the terrace lands of the Republican River Valley about 9 miles northwest of Concordia, Kans. The Dean Hanson family is the cooperator on this farm. The Webster Area Farm is located about 40 miles downstream from the Webster Reservoir, which is now under construction. Wayne Kaser is cooperating with the technical committee on this farm.

These farms have been in operation for varying periods of time. Since the Kanopolis Area Farm has been in operation for the longest period of time, it is being used to illustrate the results which farmers in the region can expect if they follow the irrigation, agronomic, engineering, fertility, and management practices recommended for irrigation farming. Information gained on each of the farms has supplied answers to many of the questions that were posed prior to the beginning of the program in 1951.

Immediately below, Grain Sorghum on Malm farm yields 103 bushels per acre. Bottom photo shows County Agent Dale Edeldute inspecting corn on the farm—yield 90 bushels per acre. ***Photos by Kansas State College.***

The Kanopolis Area Farm consists of 45.5 acres. Thirty-nine of these acres were graded and prepared for irrigation in 1951. This acreage is utilized to produce corn (grain and silage), grain sorghum, and alfalfa. The remaining 6.5 acres were deemed to be too rolling to be graded economically; however, it has been seeded to bromegrass—alfalfa and has been irrigated quite satisfactorily by the use of corrugations. It is used almost entirely for pasture.

In addition to the Irrigation Development Farm portion of the Malm's farm, they annually plant 200 acres of wheat on nonirrigated land and from 80–100 acres of grain sorghum.

The following table will serve to compare the crop yields that have been obtained by the Malm's on the irrigated portion of their farm unit with the nonirrigated yields of the same crops on surrounding farms.

Year	CROP							
	Corn (grain)		Corn (silage)		Alfalfa		Grain sorghum	
	Non-irri-gated bu./acre	Irri-gated bu./acre	Non-irri-gated tons/acre	Irri-gated tons/acre	Non-irri-gated tons/acre	Irri-gated tons/acre	Non-irri-gated bu./acre	Irri-gated bu./acre
1951	38	107	7.5	18.0	2.0	(1)	79	77
1952	15	106	5.0	19.0	1.7	7.1	18	93
1953	12	111	4.0	27.0	1.5	7.5	15	103
1954	10	90	3.0	20.0	1.0	7.8	5	86
Average	19	103	4.9	21.0	1.6	7.5	29	90

[1] Spring seeded, yielded 1.5 tons per acre.

It is apparent from the information contained in the table that the irrigated acreage has a tremendous effect on the stability of the crop production enterprise on this farm unit. Corn yields of 90–100 bushels per acre can be depended upon. It is almost a sure thing that each acre of alfalfa hay will produce 7.5 tons of hay each year. Each acre of corn silage can be depended upon to yield approximately 20 tons per year. Grain sorghum

Continued on Page 75

TRIPLE BENEFITS of a WILDLIFE AREA

How Cooperation Resulted in Conservation of Once Wasted Natural Resources

by BRYAN L. HARRIS, Bureau of Reclamation Carson City, Nevada

Top left, MATURE WINTER WHEAT. Right, LIVESTOCK USE already started on part of area. Above, MIGRATORY WATERFOWL—resting, nesting, and feeding area. ***All drawings by Bob Hines, Fish and Wildlife Service.***

Surplus water not otherwise usable and idle lands are being put to a higher beneficial use by controlled distribution and land preparation in the newly created Stillwater Wildlife Management Area and Stillwater National Wildlife Refuge in the Carson Sink near Fallon, Nev. Through cooperative efforts of the Truckee-Carson Irrigation District, the State Board of Fish and Game Commissioners of the State of Nevada, and the Fish and Wildlife Service of the Department of the Interior, in accordance with an agreement signed in November 1948, approximately 200,000 acres of land below the Newlands Reclamation project are being converted to irrigated pastures, a managed waterfowl refuge, and a regulated public shooting ground.

The Management Area is ideally located to utilize the drainage water and irrigation return flows from the Newlands Reclamation project which is operated and maintained by the Truckee-Carson Irrigation District. The lands are also strategically located, being an essential link in the important Pacific flyway of migratory waterfowl.

The three parties to the agreement are benefited by the establishment of the area. The Truckee-Carson Irrigation District benefits by pastures which supplement dairy and beef cattle enterprises of its members. The Nevada Fish and Game Commission benefits through the addition of an important public shooting ground. The Fish and Wildlife Service benefits by the refuge, particularly because resting and nesting grounds are provided for migratory waterfowl to replace natural habitats being changed or destroyed by expanding agriculture and industry.

Construction of reservoirs, irrigation canals, dikes, and other water control structures are essential in the development of the area. Other improvements are necessary such as fencing, leveling and preparing the lands for planting, leaching salts from soils to a point where desirable vegetation will grow, planting food for wildlife, and planting forage for livestock. As a result, waterfowl are provided with a series of fresh

water ponds and marshes with adequate food, plentiful cover, and freedom from botulism; fur-bearing animals, principally muskrats, are finding a new place to live and propagate; and livestock are being provided with palatable grasses and legumes in pastures which will ultimately cover about 10,000 acres.

The three parties to the agreement regarding operation and development of the Stillwater Wildlife Management Area each contribute to the program. The Truckee-Carson Irrigation District has agreed to the development of a refuge for wildlife. The Nevada State Board of Fish the Game Commissioners has agreed to develop a public shooting ground. Because of the close relationship between the refuge and public shooting ground, the Service and the Commission are developing, operating, and maintaining the facilities as one unit with costs prorated on the basis of the relative sizes of the respective areas which are being intensively developed. The Fish and Wildlife Service provides the equipment and administers the construction and related programs through a resident staff. The State Fish and Game Commission provides equipment operators, construction crews, and materials. Operations are planned jointly. The Service manages the refuge and administers the grazing. The Commission administers hunting on the section of the area opened to public shooting.

Valuable technical assistance and advice are being given by the Soil Conservation Service such as engineering, water and soil testing, determining suitable grasses to plant, etc. Other advice and assistance are being given by local stockmen who are participating in planning the livestock grazing program.

Plans include harvesting fur-bearing animals by trappers who will share proceeds of fur sales with the Truckee-Carson Irrigation District. The Service and the Commission will jointly determine the number of fur-bearing animals to be taken each year.

Progress in the development of the area has already been made and will continue as fast as funds will permit. Use of the area by wildlife and livestock has already started and will become increasingly greater as development progresses. When completely developed, and appropriate management and operation practices are being followed, lands and water which were once largely wasted will have been put to their highest capable use and another important stride will have been made in the conservation of our natural resources. # # #

SEEDED AREAS get border irrigation to leach salts from soil, below. DIKES, CANALS, and other water control structures are essential to development, top right. ROUGH LEVELING completed, right center. DISKING follows rough leveling to ready soil for planting and irrigation, lower right.

The female redhead alone raises the ducklings—the most golden of all wild ducklings

san diego's second barrel

by
JOHN D. McCOY, Area Engineer
Escondido, Calif.
Region 2
BUREAU OF RECLAMATION

PLACING LAST LENGTH of 75-inch diameter concrete pipe on Northern Division. San Diego Aqueduct diverts from Colorado River Aqueduct at outlet portal of San Jacinto Tunnel through mountain in background. ***All photos by J. M. Welch.***

As discussed in the article, The San Diego Aqueduct by Regional Director J. P. Jones in the last issue of the RECLAMATION ERA, the capacity of the San Diego Aqueduct has been increased two-fold for the importation of Colorado River water into San Diego County by the construction of the second barrel connection to the Colorado River Aqueduct of the Metropolitan Water District of Southern California.

The 72 mile long San Diego Aqueduct was designed as a twin-barreled conduit with each barrel of 85 c. f. s. capacity. The first barrel was completed in December 1947, with tunnels and several short sections of pipeline totaling about 14 percent of the length constructed to full capacity.

Following the transfer of the completed first barrel to the San Diego County Water Authority for operation and maintenance under the terms of the Authority-Navy Department repayment contract, the Board of Directors of the Authority, in order to safeguard the area from a water shortage in the event of a period of protracted drought, immediately started formulating plans to complete the aqueduct to full designed capacity. Their efforts were realized with the passage by the Congress of Public Law 171, 82d Congress, on October 11, 1951, authorizing the construction of the second barrel of the San Diego Aqueduct by the Secretary of the Navy, under the direction of the Secretary of Defense as explained in the previous article. Appropriations for the construction were made to the Department of the Navy. The authorizing legislation permitted the Navy Department to utilize the services of other federal agencies to carry out the provisions of the act which resulted in the Navy-Interior Department agreement whereby the Bureau of Reclamation designed and constructed the second barrel.

Following the start of the war in Korea in June 1950, Naval and defense establishments in the San Diego area created increased demands for water. A prevailing period of below normal precipitation and the deficiency of runoff into the local reservoirs resulted in the local storage water being depleted, although the first barrel had been operated substantially at maximum capacity since the aqueduct was placed in operation in November 1947. By April 1951, the water demand by the local agencies for deliveries from the aqueduct exceeded its capacity. To minimize the possible need for water rationing until the local reservoirs either were replenished or the second barrel constructed, the Citizens Water Conservation Committee of San Diego County was formed in April 1951 to sponsor a voluntary water conservation program.

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To expedite action on the preparation of plans and specifications, personnel were detailed from Coachella, Calif., in November 1951, to initiate the preconstruction surveys. Bids for the construction of the Northern one-half of the aqueduct comprising three schedules were advertised in July 1952, and construction work on all seven schedules was under contract by December 1952.

A summary of the contracts follows:

Specifications	Schedules	Contractor	Date of award	Date of completion	Contract earnings
DC-3754	1	R. V. Lloyd & Co.	Sept. 8, 1952	Apr. 15, 1954	$2,566,737.76
DC-3754	2	Engineering Constructors, Inc.	Sept. 8, 1952	Sept. 15, 1953	2,027,399.90
DC-3754	3	Johnson Western Constructors	Sept. 8, 1952	Mar. 3, 1954	3,169,881.48
DC-3807	1	P. & J. Artukovich Inc., and M. Miller Co.	Oct. 30, 1952	Nov. 9, 1953	705,417.22
DC-3822	1, 2, and 3	S. A. Healy Co.	Dec. 15, 1952	Nov. 1, 1954	6,784,580.72
Total					15,254,017.08

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ESCONDIDO VALLEY Lands which receive Aqueduct water.

Fifty-four inch diameter concrete pipe in place across Slaughterhouse Canyon.

Transporting pipe (16-ft. length) down steep slope for placement in trench by crane.

The Human Dragline

Above, HAND EXCAVATED drainage channel excavated into a "hardpan" to relieve seepage. At right, one of Mr. McIlwain's hand excavated channels. Far right, Mr. McIlwain, sitting on bank, views his drainage accomplishment. *All Photos courtesy of the Author.*

by WESLEY K. LUNDGREEN, Soil and Moisture Conservation Engineer, Torrington, Wyoming

Dan V. McIlwain, retired drainage expert for the Pathfinder Irrigation District, is rapidly becoming a legend in the North Platte project. His accomplishments in the draining of seeped lands rival some of the accomplishments of power draglines operating in the same areas., Mr. McIlwain's feats while somewhat physical indicate the power of "mind over matter." Armed with only a spade, he tackled jobs which caused watchers to laugh.

The problems given to McIlwain dealt with drainage. Irrigation water, while a boon to the farmer, must be controlled or it becomes a hazard. Controlling one of these hazards was his job.

As McIlwain moved on to a job of draining a seeped farm, he didn't immediately use the spade which he carried. First, he made a study of the direction of flow of the seeping water and made a careful investigation of the entrance and escapes for the water. He talked to the farmers and learned a little of the history of the appearance of the seepage water. As he gained these facts, his tools increased and using these tools he solved the drainage problem. Not always did he use his spade to dig the drain which he knew was necessary. He often called for an excavator or some other power tool to dig the major ditch. But once this was accomplished, he went to work with his spade. He usually worked alone and while he worked he carefully observed the structural conditions he encountered. By this combination he tapped the underground water veins which were producing the surface seeps. As this water flowed to the larger drains, McIlwain assisted the stream to erode its own channel. By controlling this erosion, his drainage ditches were developed. Often times the ditches weren't directed toward the most obvious place in the eyes of laymen, but they tapped these underground water sources and the surface seeps dried up.

Several years ago farmers living in the Sheep Creek Area north of Henry, Nebr. were troubled

CANVAS DROP DAM invented by Mr. McIlwain in use on farm—1918.

with excess subsurface water. Taking their problem to the late T. W. Parry, who was then Manager of the Pathfinder Irrigation District, Dan McIlwain was assigned to the job. On each side of the Sheep Creek Drain, which lies below the Interstate Canal, 5 farms were losing between 10 and 40 acres of land to seepage. As usual, armed with his spade, he sought the solution. He found where the water was being traped by a Brule bedrock barrier which was also a carrier for water where fractures occurred. As the first step in the seepage elimination, he asked the irrigation district to excavate the larger drainage ditch. After this was completed, McIlwain went to work with his spade. He worked all summer deepening and straightening the ditch and tapping underground water veins. One of the best escapes was developed from a Brule ridge. According to him, water in the Brule stratum travels in veins, but so slowly that its own pressure forces it upward toward the surface. From his preparatory studies he knew where to tap this vein of water in the ridge in order to relieve this pressure. As the water drained away, the surface seepage dried up. These farmers were soon successfully farming over the seeped land.

Old meandering eroding drains became stabilized water courses under the hand of Dan McIlwain. Whenever a drain started to meander and undercut the banks by lateral movement, he would be directed to this drain. Beginning at the lower end, he would move upstream removing debris and cutting new straight channels. In cutting these new channels, he let the water do the bulk of the work. He would dig a small ditch across the place where he wanted the drain to flow. As the water started to flow in this new channel, he would aid the erosion until a large enough channel was eroded to handle all of the drainage flow. The old channel would then be plugged with debris. This one man operation prevented the necessity of much more extensive work with a dragline later on. By accomplishing tasks like this, he became known as the Human Dragline.

Dan McIlwain lives in Scottsbluff, Nebr., at the present time, enjoying the thoughts that he has lived a fruitful and beneficial life. He has always been associated with farming in all of his pursuits. From 1900 to 1906, he farmed near Fort Collins, Colo., in 1910, he worked for the United States Reclamation Service. From 1910 to 1917 he was a millwright for the Great Western Sugar Co. From 1917 to 1929 he farmed in the North Platte project north of Minatare, Nebr. From 1929 until August 1952 he was employed as a drainage expert for the Pathfinder Irrigation District.

Even his hobbies have been directed toward irrigation. He invented the canvas drop dam used so much by farmers everywhere. This adjustable drop dam was patented on March 25, 1913, but as the patent was only good for a 17-year period, he eventually lost it. The invention consisted of an adjustable lightweight contrivance made of canvas on a hinged wood and iron framework, by which a farmer could achieve an exact control of the water. McIlwain didn't have enough capital to build this item in great quantity and in those days there wasn't a very great demand for drop dams. He sold about 200 and then released the patent to anyone who wanted to make them. Since then, thousands of these drop dams have been made and used everywhere. # # #

COLUMBIA BASIN'S ROAD PROGRAM

COUNTY ROADS like this, under construction, are scheduled to arrive with irrigation water and new farms.

by JAMES H. DODSON, County Engineer, Grant County, Wash.

Rapid development of the vast Columbia Basin project created many problems never before encountered. Among these was the construction of the essential farm service roads, without which the project could not even begin to function. Since the Bureau of Reclamation planned and laid out the farm units, it was agreed that it also would lay out, in conjunction with county and State officials, a practical system of roads to serve these units. Completion of this system of roads will assure access to every project farm. The most important roads, called county arterials, carry traffic from minor roads to State highways. Arterials, 26 feet wide, will be oil-surfaced when traffic volumes warrant the improvement. Most farms are within 2 miles of an arterial or State highway. Feeder roads, comprising 75 percent of the network mileage, connect farms to arterials or State highways.

The Bureau of Reclamation agreed to construct all necessary crossings at intersections of irrigation works with existing or projected county roads. The estimated cost of this participation is $7 million. Responsibility for development of the county road network was assumed by the project counties, but as the time for delivery of water drew near, no solution to the financing problem had been proposed.

Grant County, located at the north end of the project where first irrigation development would occur, was naturally forced into a position of leadership. Its financial ability, compared with

the urgent immediate requirements, was quite inadequate. Its existing road system totaled about 1,900 miles of largely unimproved dirt roads which satisfactorily served a dry land economy. However, the deluge of vehicles and construction machinery mobilized to construct the canal system caused rapid deterioration of the lightly-surfaced existing roads. Something had to be done quickly if the development was to go forward as scheduled.

It was estimated that $40 million worth of farm service roads would be required to serve the 1,029,000-acre project at ultimate development. The development schedule, calling for irrigation facilities for 500,000 acres by 1960, justified the expenditure of $20 million for additions to county road networks. How were these funds to be raised? No one could answer that all-important question. In fact, the responsibility for finding an answer had not been fixed. Time was running out; first water delivery was scheduled for 1952 crops.

Finally, in December 1949 a plan of action was evolved. This plan was developed by Neil R. McKay and Avery Loethspeich of the State Department of Highways; Paul Bickford of the Bureau of Reclamation; and myself. The plan was first presented to the Columbia Basin Commission at a public meeting at Ephrata in January 1950. At this meeting, the following plan of action was agreed upon, and steps were taken to put it into effect.

The plan was based on the major premise that the Columbia Basin counties would grow rapidly as a result of the irrigation development. It was believed that the counties could repay the estimated construction cost if amortization could be extended over a 25-year period. This method would permit repayment of the construction cost under existing levies and tax rates, without changing basic highway finance practice.

The first objective was to convince the State legislature that it was wise and proper to enact legislation authorizing use of the State motor vehicle fund as security for a bond issue which would be amortized by withholding from the Columbia Basin counties' share of the gasoline tax fund, but further providing that not more than 50 percent of any Columbia Basin county's share could be withheld for this purpose. Gasoline tax revenue is distributed to the counties under a factor system whereby a weight of 70 percent is allotted to trunk road mileage. Since about 90 percent of

the county road network in the project area could qualify as trunk roads under the terms of the factor law, the new roads would readily generate the revenue to meet provisions of the bond retirement program. This situation could prevail regardless of where the money was borrowed; however, only the State legislature could insure continuation of this method of distribution over a 25-year period. Thus, salability of the bonds could be assured by a guaranteeu amortization program.

The 1949 session of the legislature had established an interim committee to study the highway needs of the State of Washington and make a report presenting its conclusions and recommendations to the 1951 session. The plan was to work with this committee and at the same time carry the message to the people of the State through the media of the press, radio, and chambers of commerce of all of the principal cities. The author was selected to lead this program as Grant County road engineer. Full support was given by the Board of County Commissioners, the Department of Highways, and the Bureau of Reclamation. It was necessary for me to appear before the legislative interim commitee and persuade its members that this was a pressing problem to be placed on the regular agenda for presentation to the people at a series of hearings to be held in major population centers throughout the State. At these meetings I appeared to present the problem, answer questions, and meet the opposition that arose, which in some localities was bitter. Between interim committee meetings, it was necessary to appear in all of the major cities

to present the problem to their chambers of commerce and enlist their aid and support.

Simultaneously, I was conducting a second program to make additional construction funds available. Annually, about $2 million is allocated to the State of Washington by congressional appropriation for Federal Aid to the State Secondary Highway System. This money is in turn reallocated by the State Department of Highways as follows: 50 percent to the counties for a County Federal Aid program to be divided in the same ratio as the gasoline tax apportionment. Annual allocations to the smaller counties were so small that it was difficult to comply with the regulations governing preparation of plans and contract administration. Consequently, about $1 million in unexpended funds had accumulated, but was still allocated to the various counties. In our desperate need for finances, we quite naturally had our eye on this tidy nest egg. Department of Highways officials assured us that we could have this money reallocated to the 3 Columbia Basin counties, provided we obtained consent of the other 36 counties. A neat trick, if we could do it.

I presented our situation graphically to each of the six county district organizations. Amazingly, this approach was successful, and the money was reallocated to the Columbia Basin counties. Now we had $1 million cornered, but matching funds had to be obtained before that money was available. THIS REALLY PUT THE PRESSURE ON THE BOND ISSUE PROGRAM.

After more than a year of intense campaigning by press, by radio, and by almost endless public speaking, the big test was at hand as the legis-

(1) NEW ROADS KNIFING through eastern Washington's Columbia Basin. (2) Relocation work on four-lane highway between Grand Coulee and top of Grand Coulee Dam. (3) Beginning road relocation on highway between Grand Coulee and Electric City. (4) Highway relocation between Grand Coulee and Electric City 6 months later. (5) Brand new county road serving farms in block 40 of Columbia Basin project which received first irrigation water in April 1952. ***Photos by H. W. Fuller and H. E. Foss, Region 1.***

lature convened for the 1951 session. A bill combining $11,700,000 for the Columbia Basin project area with some $50 million bonds for three high-priority highway improvements elsewhere in the State was dropped into the hopper with the endorsement and support of the legislative interim committee. Thus, all parts of the State were equally interested in this revolutionary proposal, which involved a complete about-face for the State of Washington, which had for years proudly acclaimed its pay-as-you-go policy.

Again, I was assigned as a leader and promoter around whom the supporters of this measure could rally. I had been appointed as one of the technical advisors of the interim committee and had appeared before conferences, and roads and bridges committee meetings, as well as before joint and separate committee meetings of the house and senate supporting, defending, and promoting this measure. This issue proved a storm center during the entire session, and there probably will never be a harder fought legislative battle. However, at the last possible moment, it was finally passed. In final form, this bill provided $62,500,000 for the State and $5 million for the Columbia Basin project counties. Thus, we set forth bravely at mid-year 1951 armed with about $6 million to do a $12 million job.

Highway engineers were not to be found in this area, as the Department of Highways and the Bureau of Reclamation had long before exhausted the supply. Young men, upon graduation from college, were snapped up immediately by the armed services. There was only one course open—train our own crews. This, we set out to do, with our work already one full year behind schedule. Our plan was to make the $6 million go just as far as possible making such good use of these funds that upon their exhaustion new money would be provided. This meant that not only were we engaging in a race against time, but also every action had to be carefully weighed as to its effect on future financial support. These elements, when combined with the necessity of dealing with the public, the State, the United States Bureau of Public Roads, the Bureau of Reclamation, the railway companies, and the Public Service Commission, added to our woes.

We were able to let the first contracts early in the fall of 1951. By the fall of 1953, a total of 300 miles had been constructed. At this point we were even with the irrigation program and had plans to forge 6 months ahead in 1954 and 1 year ahead in 1955, which position we expect to maintain until the first 600,000 acres come under water.

Adams and Franklin County lands first received irrigation water by gravity in 1953. By the summer of 1954, Adams County had completed all of its road network to serve lands irrigated in 1953 and 1954. Franklin County has completed all of the road network to serve lands for which water was available in 1953 and 1954, although Grant County has done the lion's share of the work.

The 1955 State legislature approved a second bond issue of $4,300,000 for construction of county roads in the project area. With these funds we expect to complete the more than 1,200 miles of county roads necessary to serve the first 600,000 acres to be placed under irrigation. During 1955, the 3 counties will complete 249 miles of road.

On this project, it has been demonstrated that local governmental agencies can and will put their shoulders to the wheel and work hand in hand with the Federal Government in the development of this great land of ours. # # #

COUNTY ROADS FOR FARM UNITS CHANGED FROM SAGEBRUSH TO CROPLAND IN 15 MONTHS.

GRASSES CUT O. & M COSTS

by DEAN M. SCHACHTERLE, Management Agronomist, Bureau of Reclamation McCook, Nebr.

At left, Cambridge Canal, Cambridge, Nebr., immediately after construction and completion of initial grass seeding. Above, same area 4 years after initial seeding. This part of canal was not sprayed with 2,4–D during past two operating seasons. ***Photos by L. C. Axthelm, Region 7.***

Is it a sound investment to seed and establish good stands of grass on ditchbanks and other areas that are disturbed during construction of an irrigation system? Will grasses provide sufficent competition to keep undesirable and troublesome weeds from invading the banks of canals, laterals and drains?

We think these questions have been partially answered in the Kansas River projects area. The results obtained from seeding grasses on ditchbanks and other disturbed areas in the past few years, are considered permanent improvements to the irrigation systems. Thus, we are convinced that this is one sure way of CUTTING OPERATION AND MAINTENANCE COSTS.

The Kansas River Projects Area with headquarters at McCook, Nebr., is located in the Missouri River Basin and includes the entire Kansas River drainage area. The first irrigation development in the Projects Area has been in the Frenchman-Cambridge and Bostwick Irrigation Districts which include lands in the Republican River Valley from Trenton, Nebr., to Concordia, Kans. The valley is narrow in most places and it has been necessary to construct many miles of canals, laterals and protective drainage works, to service the irrigated land. Since the area is one where rainfall is sufficient in most years to promote a heavy growth of weeds on disturbed areas, we were interested in finding some desirable plant that would provide sufficient competition to suppress and prohibit weed growth on ditchbanks. Since we have two main types of vegetation in the area, broadleaf plants, and grasses, we chose a mixture of grasses that were adapted to climatic conditions and which we believed would offer sufficient competition to exclude undesirable weed growth. In choosing grasses for competitive ditchbank cover we were sure that the results would be encouraging since the native vegetation of the entire area is a mixture of grasses. Therefore, in choosing grasses for a protective cover on earth work, we were cooperating with "Mother Nature" rather than being in conflict with her.

Careful study was made of all native and introduced grasses to determine which would be best suited to local conditions. Climatic and soil conditions were the two main factors considered in choosing grasses to revegetate areas that have been denuded of natural vegetation. The climate within the projects area varies from semiarid in the western half with an average annual precipitation of 19 inches to subhumid in the eastern half with an average annual precipitation of 27 inches. Soils vary in texture from loamy sands to clay loams, the majority being sandy loams and silt loam. Also, soils were generally classified as neutral to slightly alkaline and of such structure and tilth as to encourage a luxuriant growth of grass.

The grass mixture chosen for seeding ditchbanks included introduced cool-season grasses such as Bromegrass, Intermediate Wheatgrass, Crested Wheatgrass and a small amount of Tall Wheatgrass. With these introduced grasses we added one of the native cool-season grasses, West-

ern Wheatgrass. In the immediate area of dams and borrow areas and on retired cultivated lands in reservoir areas, native grass mixtures have been used which include Little Bluestem, Big Bluestem, Switchgrass, Sand Dropseed, Side-Oats Grama, Blue Grama, Buffalograss and Western Wheatgrass.

We chose the cool-season introduced grasses to seed ditchbanks and drainage ditches because they are more easily established and produce faster growth than the native grasses. The grasses selected are fairly drouth resistant in this area since they are dormant during the hot dry summer months and produce growth only during the cool moist periods of spring and fall.

In the Frenchman-Cambridge Division the most successful mixture of grasses has been Lincoln Bromegrass, Crested Wheatgrass and Western Wheatgrass. These grasses have been seeded at the rate of 6 pounds per acre of pure live seed of each species. All seeding rates for grasses are based upon pure live seed which is determined by using the following formula:

$$\text{Pure live seed} = \frac{\text{Percent of purity} + \text{percent of germination}}{100}$$

The most successful grass mixture in the Bostwick Division consisted of Lincoln Bromegrass, Intermediate Wheatgrass, and Western Wheatgrass. These were seeded at the rate of 6 pounds of pure live seed of each species.

Most of the grasses have been seeded, under contract, by means of a grass drill. We have found that planting seed with a properly equipped drill results in better and more uniform stands. In areas where it was impossible to seed with machinery, successful stands of grass have been obtained by broadcasting seed on snow during the winter months. Higher seeding rates were required when this method of seeding was used.

The above mixtures are the main ones used. However, under special soil or topographic conditions we used variations of these mixtures and sometimes used a cover crop, such as oats, barley, or rye to protect the grass seedlings.

Most grass seedings were accomplished immediately after construction of the canal, lateral, or drain. If grass is seeded on newly constructed ditchbanks before the slopes become eroded and covered with heavy weed growth, large amounts of money and many man and equipment hours are saved by not having to smooth and prepare the seedbed prior to seeding.

The irrigation systems that we have seeded to grass are relatively new and were not operated prior to the initial seeding of grass on the ditchbanks. Therefore, we do not have comparative costs of operation and maintenance before grass was seeded and after it was seeded. We have, however, found the following beneficial uses of grass that has been planted on ditchbanks which definitely have reduced operation and maintenance costs and insured the systems against costly breaks, erosion, and delays in delivery of water during critical periods.

a. Small lateral banks have been stabilized with grass and in cases of emergency water can be spilled over the banks without damaging them.

b. Large amounts of rip-rap and many drop structures have been eliminated in large drains by establishing grass on the side slopes and bottoms. We have found that it is much cheaper to establish grass in drains than to control weeds and prevent erosion by use of structures.

c. Grass established on the tops and slopes of canal banks has stabilized the banks from erosion and has eliminated the costly weed problem. As soon as the grass is firmly established on the banks, which usually requires 3 years, weed spraying can be practically discontinued. Weed spraying operations now cost approximately $60 per mile, therefore, established stands of grass are directly saving $60 per mile per year.

d. Grass has been established on denuded areas around storage and diversion dams. Grass in these areas eliminates costly weed and erosion problems and greatly improves the appearance of these structures.

e. Established stands of grass on ditchbanks and other rights-of-way reduces the spread of weed seed to adjacent farms. This fact is highly appreciated by farmers in the irrigated area since removal of weeds from their growing crops is a costly operation to them.

In our experience grass seeded on newly constructed or old ditchbanks definitely improves an irrigation system and reduces operation and maintenance costs. Rodents which burrow into ditchbanks are reduced or practically eliminated after grasses are established. All of these desirable and beneficial uses of grass have been demonstrated in the Projects Area. We heartily recommend that grass seeding be made a part of any irrigation system where soil and climatic conditions will permit growing grass. # # #

Pictured above are the members of the WATER USERS COMMITTEE together with special advisor to the committee. Left to right are: A. A. Meredith, Charles R. Neill, Floyd Dominy, Chief, Irrigation Division, Bureau of Reclamation, LaSalle Coles, Chairman, C. Petrus Peterson, N. R. A. President, O. A. Bergeson, and R. J. McMullin. ***Photo courtesy of the N. R. A.***

NATIONAL RECLAMATION ASSOCIATION CONSIDERS RECLAMATION PROBLEMS

Five committees, made up of 27 members of the National Reclamation Association, met in Denver, 1 committee each day starting May 12, to discuss western irrigation problems and make recommendations with a view to solving them.

In addition to the committeemen, N. R. A. President C. Petrus Peterson, and Secretary-Manager William Welsh were also in attendance.

The committees and their respective memberships were as follows: *Agricultural Research Committee*—George L. Henderson, Chairman, Dean W. V. Lambert, Wayne Akin, George D. Clyde, Arthur Svendby, and LaSalle Coles; *Water Users Committee*—LaSalle Coles, Chairman, A. A. Meredith, Charles R. Neill, O. A. Bergeson, and R. J. McMullin; *Cost Study Committee*—Marvin Nichols, Chairman, M. J. Dowd, Lynn Crandall, J. M. Dille, and George Johnson; *Power Pumping Rate Study Committee*—A. J. Shaver, Chairman, Earl Lloyd, Fred E. Buck, and T. Clark Callister; *Repayment Study Committee*—Dean H. T. Person, Chairman, Harold Christy, Irving Pfoffenberger, representing A. D. Edmonston, Marvin Nichols, LaSalle Coles, Raymond F. Lund, and Arthur Svendby.

Floyd E. Dominy, Chief, Irrigation Division, Bureau of Reclamation, represented the Department of the Interior and served as an advisor to the several committees.

The meetings were considered highly successful by all concerned, and it is hoped that some very effective results will be realized. #

HOT WEEDS

by ORLAN J. LOWRY, Conservationist
and Weed Control Technician, Region 5,
Bureau of Reclamation

Fire, the great destroyer, is now used to save precious irrigation water. Recent developments in liquid gas fuels have stimulated the use of burning as a means of controlling weeds on irrigation systems.

Weeds on irrigation distribution systems obstruct the normal flow of water, increase operation and maintenance expenses, and consume valuable water. If they are allowed to produce seed and scatter to farms they rob the lands of their greatest assets, water and plant food, and increase cultivation and tillage expense.

Therefore, weeds, including Johnson and similar grasses, on canals and laterals must be reduced to a minimum and their production of seed must be prevented. Chemicals and mowing have been employed successfully to control weeds on farm and Irrigation District ditches but due to the possibility of damage to susceptible farm crops chemical control may have some disadvantages in certain areas. Burning, which has been greatly improved by new fuels and equipment, is gaining in importance on many southwestern irrigated projects where cotton and other susceptible crops are grown.

The practice of weed burning dates almost to the beginning of the petroleum industry, but during the past few years improvements have made the practice of burning young green weeds more successful. Not many years ago, fuels such as distillate and kerosene were used almost entirely. While these are high in heat values mobile weed burners are often inefficient and uneconomical becase of combustion problems. With these fuels, it is necessary to artificially produce fuel pressure. In some cases compressed air is used to improve combustion efficiently but this has not proved as effective as is desired.

Controlling green weeds by burning is more practical since liquid gas, butane and propane, have been developed. These petroleum compounds are liquids under pressure but become a gas when released. The boiling point of liquid gas is low and at normal temperatures during the

Below, Boom of this rig, constructed in Tucumcari project shop, is horizontally and vertically controlled by hydraulic mechanism. At right, hydraulically operated liquid gas burner. Lower right, note dark color of small grass burned by shop consructed butane equipment.

weed burning season it will maintain adequate pressure in the tank to produce a most efficient penetrating flame. Liquid gas in New Mexico, Texas, and Oklahoma is readily available, is economical, and is considered to be a safe fuel for weed burning when proper precautions are taken.

On ditches heavily infested with weeds, two burnings are ordinarily recommended. The first burning is accomplished with the equipment moving at a rate of about 3 miles per hour which usually results in an effective kill even though there is little immediate change in plant appearance. The second burning, made about a week to ten days later, consumes the old dead tops and retards any regrowth or new plants. When burning dry weeds the rig moves about 5 or 6 miles per hour. By burning and reburning when green plants reach a height of 6–8 inches during the growing season, weedy grasses or other undesirable vegetation on the inside slopes of ditches, have been successfully controlled.

The average cost for burning green weeds on the Carlsbad project, N. Mex., for the 1954 season was $8.78 per mile for burning on small ditches. The cost for maintaining 35 miles of laterals on the Balmorhea project, Texas completely free of Johnson grass growth was $7.80 per mile for burning. The use of liquid gas weed burners has been employed on the Rio Grande project, Texas-New Mexico for about 6 years with the results that winter clean-up and ditch cleaning operations have been reduced to a minimum. It also has made ditch banks more accessible for inspections which has reduced the number of serious ditch breaks.

The introduction of liquid gas weed burners, along with maneuverable counterbalanced or hydraulically controlled burner booms, has materially increased the efficiency of the burning method for controlling weeds. Other projects, where liquid gas can be obtained readily and economically may find this fuel, and the simple equipment required for its use, to be of advantage to them. #

YOUR MAGAZINE

Are there particular types of articles which you would like to see in the ERA that we have not printed to date? If so, please let us know, and we shall do our best to comply with your wishes.

Kansas' Report

Continued from Page 60

yields of 85–100 bushels per acre are a reality.

In short, the Malms can predict each year with a high degree of accuracy the production from their irrigated acreage. They can plan their other farm production and livestock production enterprises on a stable plane.

"Yes," Mr. Malm states, "the irrigated acreage does stabilize our farming program. In fact, it's unfortunate but we'll have to use the income from our irrigated acreage to pay the production costs on some of the nonirrigated crops. An example of this is 50 acres of nonirrigated milo which I planted. The total income from these 50 acres was $40 and I paid $500 cash rent for the land plus all of the other production costs."

Is irrigation profitable? Mr. Malm answers this question by saying, "The 4-year average net income per acre from the irrigated acreage is $70.50 per acre. This net income has been realized in spite of the high production costs that are a part of irrigated farming. In order to realize these profits, it has been necessary to plant crops thick, use fertilizer very liberally, and irrigate before the crop begins to suffer for moisture."

A very short rotation is followed on the farm in an effort to maintain the soil in a relatively high state of fertility. In spite of this, it is necessary to use commercial fertilizer liberally. Nitrogen has been applied to the corn in amounts up to 150 pounds per acre.

The need for commercial fertilizer is determined by interpreting the soil fertility analysis each year, upon the past cropping history for the field, and upon some knowledge of the needs of the particular crop being planted.

The past 4 years of work with this program has reassured us in Kansas that this cooperative local farmer-owner development farm approach is a highly satisfactory method for demonstrating crop responses as well as on the farm cultural and management practices which are a requisite to profitable irrigation farming. ###

PORTER W. DENT DEAD

Porter W. Dent, who served in various capacities with the Bureau of Reclamation, including District Counsel, Assistant to the Commissioner, Assistant Commissioner and Chief Counsel, from 1910 to 1934, died of a heart attack in St. Petersburg, Fla., on May 31.

San Diego

Continued from Page 64

About three-fourths of the contract cost of the second barrel was for supplying and delivery of pipe to the job-site. However, the total of all contractors payroll was about 694,000 man-hours on the job-site.

Water in the San Diego Aqueduct flows by gravity from the intake at elevation 1,500 to the city of San Diego's San Vicente Reservoir at elevation 760. Diversions are made at turnout structures located along the aqueduct. The second barrel was constructed of precast concrete pipe, except at the cross of the San Luis Rey River where steel pipe was used to accommodate the 900 foot hydrostatic head. Noncylinder type concrete pipe was used for hydrostatic heads up to 100 feet and cylinder type concrete pipe was used for heads from 100 feet to a maximum of 650 feet. The distance between centerlines of the 2 barrels varies from 15 to 75 feet. The aqueduct was constructed over flat to rolling lands in the northern section to rough and rugged terrain in the southern part and consists of a series of inverted siphons, the longest of which is 12½ miles in length. To fit the hydraulic gradient for the full length of the line to the limitations imposed by the available head and topography, precast concrete pipe was utilized totaling 48,036 feet of 75-inch, 77,588 feet of 60-inch, 29,230 feet of 54-inch, and 160,478 feet of 48-inch and 6,874 feet of 58-inch steel pipe for the San Luis Rey River crossing.

Before a completed section of pipeline was accepted from the contractor, hydrostatic tests to determine the leakage losses were required. The excellent workmanship performed by all contractors and pipe suppliers is demonstrated by the actual loss for the entire length of pipeline averaging about 17 percent of the maximum allowable loss permitted by the specifications.

Because of the current dry period, together with increased water demands, there has been excessive overdraft of local underground and surface reservoirs in the San Diego area with the resultant decrease in the safe water yields of the local sources. This situation has greatly emphasized the dependency of the area upon the importation of water. For example, Colorado River water has supplied about 60 percent of the water consumed by all member agencies of the San Diego County Water authority during the period of July 1, 1948, to June 30, 1954. To increase the supply available from the aqueduct, the completed northern half of the second barrel was placed in operation on April 6, 1954, and the southern half on October 2, 1954. On March 15, 1955, reservoirs available to member agencies for storage of local supplies, with total capacity of 696,000 acre-feet were only 16 percent full.

The San Diego County Water Authority as a member agency of the Metropolitan Water District of Southern California, participates in the importation of Colorado River water through the Colorado River Aqueduct into the Southern California Coastal Area. Deliveries of Colorado River water into San Diego County through the San Diego Aqueduct are distributed by the Authority to its member agencies. The constituent area of the Authority includes 8 cities, 5 irrigation districts, 5 municipal water districts, and 3 public utility districts. The following tabulation summarizes the population and assessed valuation of the Authority in comparison with San Diego County and shows that although the Authority includes only about 11 percent of the area in the county, it serves about 93 percent of the population and includes about 88 percent of the assessed valuation of the county.

Authority Constituents and San Diego County, July 1954

Item	Authority constituents	San Diego county	Percent authority
Area acres	294, 189	2, 725, 100	10. 8
Population	679, 800	729, 600	93. 2
Assessed valuation	$736, 636, 494	$832, 232, 380	88. 5

The city of San Diego, the largest member of the County Water Authority, has a population of about 452,000 and an assessed valuation of $507,-527,340 covering an area of 76,288 acres.

In addition to supplementing the domestic supply for a population of nearly 680,000 water from the aqueduct serves the industrial requirements and the needs of military installations including the 11th Naval District at San Diego, and supplements the municipal supply for the eight cities within the Authority. Most of the citrus and avocados grown in San Diego County are produced from lands now entitled to receive a supplemental

water supply from the aqueduct. During the 1954 calendar year the San Diego County income from citrus products was valued at $8,517,000 and avocados at $7,044,000.

The repayment to the United States of the true-cost of the second barrel was incorporated in a supplemental agreement to the repayment contract for the first barrel. Under the Navy Department-Water Authority contract, the Authority agreed to repay the United States the true cost of the second barrel over a period of 40 years with interest at the rate of 2.599 percent. On February 28, 1955, the repayment contract for the second barrel was effected by declaration of completion of construction and transfer of operation and maintenance of the completed aqueduct to the Water Authority.

Completion of the San Diego Aqueduct to designed capacity by the construction of the second barrel marks another step in the area's effort to meet the continually growing water needs.

# # #

How to Determine the Number of Plants or Shrubs in an Acre

To estimate the number of plants required for an acre, at any given distance, multiply the distance between the rows by the distance between plants, which will give the number of square feet allotted to each plant, and divide the number of square feet in an acre (43,560) by this number. The quotient will be the approximate number of plants required, as shown in the following table:

Number of shrubs or plants for an acre

Distance apart	Number of plants	Distance apart	Number of plants
3 by 3 inches	696, 690	6 by 6 feet	1, 210
4 by 4 inches	392, 040	6½ by 6½ feet	1, 031
6 by 6 inches	174, 240	7 by 7 feet	881
9 by 9 inches	77, 440	8 by 8 feet	680
1 by 1 foot	43, 560	9 by 9 feet	537
1½ by 1½ feet	19, 360	10 by 10 feet	435
2 by 1 feet	21, 780	11 by 11 feet	360
2 by 2 feet	10, 890	12 by 12 feet	302
2½ by 2½ feet	6, 960	13 by 13 feet	257
3 by 1 feet	14, 620	14 by 14 feet	222
3 by 2 feet	7, 260	15 by 15 feet	193
3 by 3 feet	4, 840	16 by 16 feet	170
3½ by 3½ feet	3, 555	16½ by 16½ feet	160
4 by 1 feet	10, 890	17 by 17 feet	150
4 by 2 feet	5, 445	18 by 18 feet	134
4 by 3 feet	3, 630	19 by 19 feet	120
4 by 4 feet	2, 722	20 by 20 feet	108
4½ by 4½ feet	2, 151	25 by 25 feet	69
5 by 1 feet	8, 712	30 by 30 feet	48
5 by 2 feet	4, 356	33 by 33 feet	40
5 by 3 feet	2, 904	40 by 40 feet	27
5 by 4 feet	2, 178	50 by 50 feet	17
5 by 5 feet	1, 742	60 by 60 feet	12
5½ by 5½ feet	1, 417	66 by 66 feet	10

The Editor's Column

The following facts have been gleaned from the United States Department of Agriculture's statistical summary, dated May 17. We hope that you find them helpful.

Crop Progress Nearly Normal

Crop operations gained pace during April and in early May approached normal status over much of the country. Good soil moisture for germination and growth of corn and soybeans, also good prospects for fall-sown grains, spring grains, and forage crops are general in north-central and north-eastern areas. Prospects are less encouraging in some southern sections, where March freezes set back crops, and remain discouraging in parts of the southern Great Plains, where chronic drought persists. Crop growth in Pacific Coast States, as well as much of the West, was delayed by cool April weather.

Irrigation water supplies improved in some northern areas of the West, but remain below average in most southwestern areas.

Big Rye Crop

The 1955 rye crop of 29.3 million bushels is the largest since 1942 and nearly one-fourth larger than the 1954 crop. About 43 percent of the acreage seeded to rye is expected to be harvested for grain—about the same proportion as last year.

Hay Condition Equals Average

Hay crops prospered in April from favorable soil moisture in most northern and northeastern parts of the county, where prospects surpass those of a year ago. But growth in Western States was delayed by cool weather, and in parts of Kansas, Oklahoma, and Texas early alfalfa growth reflects some March freeze damage. The May 1 condition of 85, which equals average, points to a larger than average 1955 total hay tonnage from the large prospective acreage. A record proportion of alfalfa is expected out of a total hay crop of at least 105 million tons. Pasture condition of 79 percent on May 1 was one point below a year ago and 3 points below average.

More Cattle on Feed

Cattle and calves on feed for market in the 14 major feeding States on April 1 totaled 4,547,000 head—about 12 percent more than a year earlier. The April 1 number on feed is 11 percent below the January 1, 1955, level. In the 3 Corn Belt States—Illinois, Iowa, and Nebraska—where comparable data for 1954 are available, 10 percent more cattle were placed on feed during the first quarter than during the first quarter of 1954, while marketing of feed cattle were 2 percent lower. Shipments of stocker and feeder cattle into the Corn Belt States during the January-March period were 11 percent larger than for the same period a year earlier.

LETTERS

Welcome Back *Irrigation Farmer*

DEAR SIRS: I want to congratulate you on the excellent job you are doing with the ERA. I first came in contact with the magazine when working for the Bureau in Boulder City, Nev., in 1947 and have followed it quite closely ever since. Keep up the good work.

Publication of the Irrigation Farmer, which has not been published since 1949, is being resumed in July. The magazine will go free to irrigators, farmers who plan to irrigate within 1 year, and irrigation farm owners.

I would like to reprint an article from the ERA in one of our first issues. It is the story "Streamlined Pipe Moving" in the May issue. I would like to know your policy on this and if I could have Mr. Sanders' address so pictures may be obtained.

Very truly yours,
(Sgd.) Don Flory,
Irrigation Farmer,
P. O. Box 344, Holdrege, Nebr.

(Permission gladly granted.—Ed.)

Good Question!

DEAR SIRS: I wonder if you realize the suspense you created in February issue of RECLAMATION ERA in the article, "More Dry Years Ahead," page 4 bottom of column 1 we have the sentence ending: "* * * but it is likely that 1954 will prove to be the minimum sun spot year." That's what really interests me very much. Well, was it?

Best wishes,
Thure Rosene,
3956 East Elliott,
Detroit 7, Mich.

This was the observation of Mr. I. R. Tannehill, an informed scientist in weather forecasting at the time he wrote the article "More Dry Years Ahead." As is the case in all forecasts, whether it's with the weather or some other topic, only time will bear out their accuracy or inaccuracy.—Ed.

Frog Raising?

DEAR SIRS: Your excellent publication, The RECLAMATION ERA, is always interesting to us, as being very close to our own efforts and work.

Your article, "Like To Be a Frog Farmer?", appearing in your issue of June 1953, has been before us for some time as an item of evidence in a wide-scale inquiry this Bureau instituted. Having been many times asked whether artificial frog farming (the kind your article describes) can be made to pay, our Director, Dr. Gustave Prevost, made inquiry of biologists and others in all American states and Canadian provinces whether they had data to show that it could succeed. Practically every one of the many answers said distinctly "No." Not one said "Yes."

Your article spoiled this virtual unanimity, so the present writer consulted the California Department of Fish and Game. The Senior Fisheries Biologist, Dr. Leo Shapovalov, informed us that the business of which the article treats has since failed. He repeats a previous statement to our Director: "Insofar as I know, commercial frog farming has not been generally successful in California."

If you have new evidence that frog farming can succeed, would you like to let us know so that we can give the right information to our people interested in this farming.

Yours very truly,
(Sgd.) Richard L. Seguin,
Biologist, Quebec Biological Bureau, D'634, University of Montreal, P. O. Box 6128, Montreal 2, P. Q.

Early in 1954 when Mr. Ondricek (featured in the article "Like To Be a Frog Farmer?") was ready to market his first crop of frogs thieves stole most of those that were of marketable size. It is known that he lost as many as 200 marketable frogs to thieves in one night alone. He had been able to overcome all obstacles in raising his frogs to marketable size but could not devise an inexpensive and certain method of preventing loss of mature frogs through thievery. As a result of this turn of events he converted his ponds to the production of bait minnows.

Mr. Ondricek is convinced that frogs can be raised successfully as a commercial enterprise. He is also convinced that more frogs can be raised per unit of area in artificial ponds than can be raised in the natural state. However, when asked which he would rather raise, frogs or minnows, he said minnows because they require much less work. It required about 3½ hours a day to feed the frogs whereas only ½ hour per day is needed to feed the minnows.—Ed.

R & B Pays Dividends

DEAR SIRS: We would like your permission to reproduce the article "Rehabilitation and Betterment Pays Dividend" by R. J. McMullin which appeared on pages 20 to 23 in the February 1955 issue of the RECLAMATION ERA. The reprints will show—Reprinted by the Portland Cement Association from the RECLAMATION ERA February 1955.

I trust you will be able to give us this permission.

Yours very truly,
(Sgd.) E. C. Wenger,
Manager, Conservation Bureau, Portland Cement Association, Chicago 10, Ill.

As always, we were glad to grant permission.—Ed.

Thank You, Lieutenant!

DEAR SIRS: Reference is made to your note in the May issue of the RECLAMATION ERA concerning copies of back issues for "Get Acquainted" purposes. I should like to nominate Mr. Charles C. Beckner, Naval Station, % PM Seattle, Washington, as one to be mailed some back issues, since I have personal knowledge of his deep interest in this and allied fields.

After reviewing my first issue of this publication, it is my belief that I will be on your (subscription) list for a long time, and therefore, I too would appreciate any back issues.

Taking this opportunity to thank you, I am.

Sincerely yours,
(Sgd) J. H. Bradberry,
Lt. J. H. Bradberry, MSC USN, Naval Station Navy #127 (Box 2), % PM, Seattle, Wash.

Streamlined Pipe Moving

DEAR SIRS: The May 1955 issue of the RECLAMATION ERA had an article entitled "Streamlined Pipe Moving."

We will appreciate receiving the address of Mr. Sanders, the designer of the pipe mover described in this article.

Very truly yours,
(Sgd.) S. X. Kaplan,
Midwest Irrigation Co., 2700 Hawkeye Drive, Sioux City, Ia.

As we have had a number of similar inquiries, the inventor, Mr. Ralph M. Sanders, can be reached at 615 Park Place, Pittsburgh 9, Pa.—Ed.

BOOKS

Floods

by William G. Hoyt and Walter B. Langbein

This is a comprehensive report on one of the most destructive phenomena in American life—the flood.

The authors, leading scientists and members for many years of the United States Geological Survey, analyze the ways in which floods start and gather momentum, the damage they inflict, and what man can do to adapt to them, prevent them, and protect himself against them. They outline the judicial and legislative framework involved and suggest certain important changes. They describe the problems, projects, and plans in every major basin in the United States, and present a history of our floods since 1543, by years and by streams. Fifty-one drawings and 31 photographs supplement the highly readable text.

Legislators, city planners, insurance executives, bankers, Red Cross workers, and others concerned with the hazards of the 10 million people who live on the flood plains of the United States—not to mention those 10 million people themselves—will find this book of particular interest. Hydrologists, conservationists, engineers, and other professional readers will welcome its

discussion of technical aspects and its forthright stand on many controversial matters, such as zoning, insurance, relief, and upstream *v.* downstream protection. And many flood-conscious citizens who pay taxes for extensive protective measures or make contributions for relief and reconstruction will find this book a fascinating and enlightening experience.

Princeton University Press

Land Judging

by Edd Roberts

The evaluation of soils has in recent years been brought to a high state of technical efficiency—in the laboratory, through standard land classification charts, and by other technical means. But the practical application of this scientific information by thousands of people, rather than merely by a few, has waited on a brand-new development, land-judging contests. In this book, Edd Roberts of the Oklahoma A & M College, one of three pioneers in these contests, provides the authoritative manual of procedure for this great new activity.

Mr. Roberts defines all of the terms used in land judging, many of which have not been defined before. He shows, step by step, how to judge land by physical characteristics and location. He tells in detail about judging land by soil tests and classifications. He analyzes the land-judging score card. He explains the method of conducting a land-judging contest. And he points out the importance of observation in land judging: crop cover, stream overflow, slopes, etc.

University of Oklahoma Press

The Flood Control Controversy—

by Luna B. Leopold, U. S. Geological Survey, and Thomas Maddock, Jr., United States Bureau of Reclamation

Written by two hydraulic engineers with varied and extensive experience in the field of water resources and land management, this book describes and analyzes the technical problems in relation to the economic and political issues of flood control. Its purpose is to give a clear exposition of the hydrology of rivers and floods and of the types of control measures which are possible. At the same time, it offers an impartial analysis of the effectiveness of upstream and downstream programs for flood control as advocated by the Department of Agriculture and the United States Army Corps of Engineers.

The origin and nature of this controversy between upstream and downstream interests are fully explained. In the light of the hydrologic facts that are the key to this matter, the different methods used by the two federal agencies in planning and justifying their programs are compared and evaluated in nontechnical terms.

This book will enable individuals and groups interested in or responsible for public policy on water problems in a particular area to judge the merits of a current and proposed soil conservation or flood protection program. Agricultural scientists, engineers, and others directly concerned with developing water resources will find here an unbiased assessment of present flood control measures and a lucid presentation of the hydrologic considerations that are so often overlooked.

The Ronald Press Company

Weather

Continued from Page 58

high-level tropical cold low-pressure regions follows increases in the amount of ultra-violet or X-rays being received from the sun. The layman, familiar with the weather charts in his daily paper, knows that low pressure and a change for the worse in weather go hand in hand. Using this relationship, Palmer has successfully made predictions about the direction and strength of Pacific winds at high levels. Again, you may have read that when Pacific airliner flights can take advantage of these winds, hours are cut off and stops eliminated on the Tokyo-Honolulu run. Airlines in general use the "jet stream" winds today whenever possible for a "free" assist; the ability to predict their intensity and direction could greatly improve high-altitude, long distance flight.

Such evidence tends to confirm a theory developed some years ago by Dr. H. C. Willett of the Massachusetts Institute of Technology.

Dr. Willett has developed statistics on large scale atmospheric air movements that seem to show that all changes of weather and climate, from day-to-day variations to those of geologic-period time-scale, must have the same origin.

Dr. Willett further concludes that no other cause but solar change seems adequate to explain all of the phenomena of climatic change. Admittedly, weather changes can be triggered by changes in ocean currents, by alterations in the burden of volcanic dust carried by the atmosphere, by changes in mountains and seas, even by the atmospheric contamination produced by man himself. But none of these are adequate to explain the sudden and worldwide alterations of weather patterns that bring us our largest and most important changes of wind, temperature, and rainfall.

Dr. Willett's theory is that the normal state of the weather, when neither particles nor ultraviolet pulses of energy from the sun disturb it, is a stable state in which storm tracks recede from the temperate zones and move in eastward courses that lie closer to the north and south poles.

Bursts of ultraviolet or corpuscular emission from the sun, one can easily imagine, might disturb this steady circulation scheme, and that is just what Willett suggests. But the effects of the two kinds of emanations would be different. Corpuscles would be funneled into the polar regions of the earth by the earth's magnetic field. The ultraviolet effects, on the other hand, would be maximum in the tropics, where the sun is most nearly overhead.

By knowing where and when such emissions occur, scientists may some day be able to predict in some detail the disrupting effects on world weather patterns. There are some indications, if this kind of reasoning is correct, that we will see a marked worsening of world climate, with colder, stormier weather over most of the United States shortly after the coming solar activity maximum. This we can now pinpoint for about 1957 or 1958.

In 1942 the High Altitude Observatory began making regular observations of the corona, the faint atmosphere of gasses that surrounds the sun. During the course of these observations it was discovered that changes in the brightness of green light in the corona, was related to short wave radio communication on earth. Daily observations of this green coronal light are today an integral part of techniques for accurately predicting short wave radio communication conditions several months in advance. We have also assisted in developing equipment and techniques now in use at Sacramento Peak, N. Mex., for observing and reporting, on a telegraphic basis, sudden explosions on the sun's surface, called flares, which in a matter of minutes can cause serious or complete disruption of shortwave, long-range radio communication.

This precedent for predictable short-to-long term relationships of solar changes to terrestrial events is another reason we are hopeful that similar relationships might be developed for the weather. As a matter of fact, E. D. Farthing of Trans World Airlines has found a most suggestive relationship between changes in the sun's coronal green light and changes in precipitation at Kansas City. The coronal data were furnished by the High Altitude Observatory, and are exactly the same as those used in making the radio propagation predictions!

I am very hopeful that meteorologists and solar astronomers, working together, will develop at the very least, predictable relationships between the sun and weather for long-term, drouth-type periods. At the best, they will add to this information of value in predicting weather.

Either way, your life and mine will be drastically altered, and scientific research will have alleviated one more of those uncertainties that make life so interesting—but unfortunately, often so uncomfortable. # # #

MAJOR RECENT CONTRACT AWARDS

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DC-4307 (Schedule 1).	Missouri River Basin, Wyo.	Apr. 7	Construction of Hanover pumping plants Nos. 1, 2, 3, and 4, and canals and laterals.	Commercial Builders, Inc., Moscow, Idaho.	$311,488
DC-4307 (Schedule 2)	do	do	Construction of Bluff pumping plants Nos. 1 and 2 and laterals.	Eagle Construction Corp., Loveland, Colo.	82,513
DC-4338	Yakima, Wash	do	Completion of Chandler power and pumping plants and appurtenant works.	Western Electrical Construction Co., Portland, Oreg.	158,000
DC-4353	Missouri River Basin, Nebr.-Kans.	Apr. 15	Construction of earthwork and structures for Courtland Canal, station 1740+30 to 1836+19 and 1839+45 to 1844+00; and lateral 34.4 and drains.	Ace Construction Co., Omaha, Nebr.	226,483
DC-4354	Central Valley, Calif	Apr. 28	Construction of earthwork and structures for Corning Canal, station 361+75 to 624+00, Sacramento Canals Unit.	J. H. Trisdale, Inc., Redding, Calif.	474,361
DC-4355 (Schedule 3)	Minidoka, Idaho	May 4	Construction of unit A pumping plant, utilizing steel pipe in discharge line.	W. R. Cahoon Construction Co., Pocatello, Idaho.	373,194
DC-4359	Yakima, Wash	May 6	Alterations for Prosser Diversion Dam and enlargement of Chandler Canal, station 1+93.7 to 128+80.	Paul Jarvis, Inc., Wenatchee, Wash.	420,613
DS-4363	Parker-Davis, Ariz.-Nev.-Calif.	May 19	One 30,000/40,000-kilovolt-ampere autotransformer for Gila substation.	Legnano Electric Corp., New York, N. Y.	118,878
DC-4367	Cachuma, Calif	May 3	Construction of earthwork, steel pipe lines, pumping plant, 50,000-gallon elevated steel water tank, and structures for Carpinteria distribution system, Shepard Mesa extension.	J. E. Young Pipe Line Contractor, Inc., Los Angeles, Calif.	74,866
DC-4370	Carlsbad, N. Mex	May 10	Enlargement of Alamogordo Dam	List and Clark Construction Co., Kansas City, Mo.	598,618
DC-4374	Missouri River Basin, S. Dak.	May 3	Stringing conductors and overhead ground wires for 130.3 miles of Big Bend-Huron-Watertown 230-kilovolt transmission line.	Hallett Construction Co., Crosby, Minn.	1,127,942
DC-4375	Yakima, Wash	May 24	Construction of earthwork, canal lining, and structures for Main Canal, station 1325+00 to end; and Hover wasteway, Sta. 1+00 to 53+96.	Murphy Bros., Inc., Spokane, Wash.	319,718
DC-4378	Missouri River Basin, Nebr.	May 12	Construction of earthwork and structures for Sargent Canal, station 595+00 to 1109+78.67 Bk; and Sand Canyon wasteway.	Ace Construction Co., Omaha, Nebr.	476,266
DC-4382	Columbia Basin, Wash	June 21	Construction of earthwork, pipe lines, and structures for Block 47 laterals, sublaterals, and wasteways, East Low Canal laterals.	Cherf Bros., Inc., and Sandkay Contractors, Inc., Ephrata, Wash.	468,671
DC-4394	Columbia Basin, Wash	June 17	Construction of earthwork, lateral lining, and structures for east part of block 89, laterals, sublaterals, wasteways, and drains, West Canal laterals.	Henry C. Werner and Tauf Charneski, Eugene, Oreg.	1,211,386
DC-4396	Missouri River Basin, Nebr-Kans.	June 8	Construction of earthwork, structures, and surfacing for county road improvement, including a steel and concrete bridge over John's Creek, Lovewell Dam and reservoir.	Claussen-Olson-Benner, Inc., Holdrege, Nebr.	113,254
DC-4405	Missouri River Basin, N. Dak.	June 28	Construction of Fargo substation and modifications at Jamestown substation.	Gustav Hirsch Organization, Inc., Columbus, Ohio.	431,871
DC-4424	Weber Basin, Utah	June 30	Enlargement of Pineview Dam and relocation of highway	Utah Construction Co., Salt City, Utah.	1,372,172
100C-212	Palisades, Idaho	Apr. 6	Clearing 10,936 acres of Palisades reservoir site, part II	Curtis-Rhodes-Austin Co., Boise, Idaho.	158,236
100S-215	Minidoka, Idaho	June 7	Thirty-three deep well-pumping units for Group 4 wells	Layne and Bowler, Inc., Memphis, Tenn.	243,134
100C-218 (schedule 1)	Minidoka, Idaho	June 6	Construction of earthwork, pipelines, and structures for Unit A laterals.	Duffy Reed Construction Co., Twin Falls, Idaho.	350,065
200C-269	Central Valley, Calif	Apr. 5	Construction of Nimbus fish hatchery	Johnson, Drake and Piper, Inc., Oakland, Calif.	457,852
703C-369 (schedule 1)	Missouri River Basin, Wyo.	June 10	Construction of ten 2-bedroom residences, two 7-stall garages, trailer court, and utility building for Glendo government housing.	Eagle Construction Corp., Loveland, Colo.	155,719

WORK CURRENTLY SCHEDULED THROUGH SEPTEMBER 1955*

Project	Description of work or material
Boise, Idaho	Rehabilitating Black Canyon Dam will include preparing existing concrete surfaces to receive new concrete, placing anchor bars, installing drains, and laying new concrete face slabs. Eight miles northeast of Emmett.
Buford-Trenton, N. Dak.	Constructing crib-type retaining wall to stabilize intake channel at Buford-Trenton Pumping Plant, near Buford.
Do	Modifying a lateral wasteway to collect surface water runoff, constructing a terminal wasteway with a regulating check, rehabilitating two county road bridges, and placing riprap around two existing erosion control structures. Near Williston.
Central Valley, Calif.	Constructing about 8 miles of earth canal, partly earth lined, with bottom widths of 16 to 10 feet, including culverts, bridges, monolithic and precast concrete pipe siphons, drainage inlets, and checks. Corning Canal, near Corning.
Do	Constructing concrete check in Friant-Kern Canal and furnishing and installing three 14- by 16-foot radial gates and electrically-operated hoists and equipment. Eight miles north of Shafter.
Do	Constructing trashrack structure, reinforced concrete channel, fish deflector, bypass pipe, and fish handling structure and equipment including pumps and piping. Delta-Mendota Canal, about 7 miles northwest of Tracy.
Colorado-Big Thompson, Colo.	Rehabilitating and enlarging about 23.8 miles of the South Platte Supply Canal, near Erie and Ft. Lupton.
Do	Replacing 3 existing single-phase transformers with 1 three-phase transformer at Green Mountain Power Plant, including constructing foundations, furnishing and erecting structural steel for modification of the existing structure, and installing electrical equipment, major items of which will be Government-furnished. Near Dillon.
Columbia Basin, Wash.	Constructing about 26 miles of concrete-lined laterals with bottom widths of from 5 to 2 feet and 9 miles of wasteways and drains with bottom widths of from 8 to 2 feet. Block 89, south of Ephrata.
Do	Constructing a 15-foot 4-inch diameter concrete and steel pipe siphon, 15,700 feet long, including inlet and outlet structure. Wahluke Siphon, about 6 miles south of Othello.
Eden, Wyo.	Earthwork and structures for about 8 miles of 160- to 25-cubic feet per second-capacity laterals, about 16 miles of 50- to 6-cubic feet per second-capacity sublaterals, and about 15 miles of 18- to 6-cubic feet per second capacity drains and wasteway channels. About 30 miles north of Rock Springs.

*Subject to change.

WORK CURRENTLY SCHEDULED THROUGH SEPTEMBER 1955*—Continued

Project	Description of work or material
Fort Peck, Mont.	Constructing additions to the 115/57-kilovolt Glendive Substation will include constructing foundations, furnishing and erecting steel structures, and installing a bank of four single-phase, 6,000-kilovolt-amperes, 115-kilovolt transformers, a 5,000-kilovolt-amperes, 69-kilovolt regulating transformer, and associated electrical equipment, major items of which will be Government-furnished. At Glendive.
Gila, Ariz.	Constructing about 16 miles of 60- to 15-cubic feet per second-capacity concrete-lined laterals and four 60- and 40-cubic feet per second-capacity low-head pumping plants. Ralph's Mill Area, 40 miles east of Yuma.
Grand Valley, Colo.	Rehabilitating check structure, constructing bench flume, replacing 10 existing metal flumes with precast concrete siphons or concrete flumes, and constructing wasteways. All materials to be furnished by the contractor. Orchard Mesa Division, near Grand Junction.
Kendrick, Wyo.	Constructing additions to the 115-kilovolt Casper Substation will include foundations, furnishing and erecting steel structures, and installing electrical equipment, major items of which will be Government-furnished. Near Casper.
Middle Rio Grande, N. Mex.	Clearing and cleaning about 30.3 miles of open drains and constructing about 3.3 miles of new drain. BW-3 and SW-3, near Los Lunas.
Do	Clearing and cleaning about 36.5 miles of open drains and constructing about 2 miles of new drains near Albuquerque.
Do	Constructing 1,300 linear feet of 6.5-foot monolithic concrete or precast concrete pipe siphon and wasteway, and a concrete drop structure and radial gate heading structure. All materials to be furnished by the contractor. Near Albuquerque.
Minidoka, Idaho	Constructing about 18.6 miles of unlined and earth-lined laterals with bottom widths of 3 and 2 feet and 20 riprapped stilling pools and 5 well discharge stilling structures. Constructing concrete structures along the laterals, including checks, drops, siphons, weirs, lateral and farm turnouts, and corrugated metal flumes. All materials to be furnished by the contractor. Group 4 Wells, Unit B, North Side Pumping Division, near Rupert.
Do	Constructing 2,200 square feet of open-stall garage and 3,100 square feet of open-stall truck and equipment storage with steel or timber framing and metal siding and roofing. All materials to be furnished by the contractor. North Side Pumping Division, at Rupert.
Missouri River Basin, Kans.	Constructing about 13.5 miles of canal with bottom widths of 14 and 12 feet, and 10 miles of laterals and drains. Kirwin Main Canal, near Kirwin.
Do	Two 25- by 20-foot spillway radial gates including pin bearing support and wall and sill plates. Estimated weight: 77,000 pounds. For Lovewell Dam.
Missouri River Basin, Mont.	Constructing a 7-foot diameter horseshoe tunnel about 2.6 miles long. Helena Valley Tunnel, 15 miles east of Helena, adjacent to Canyon Ferry Dam.
Do	Clearing trees and brush from about 1,200 acres of reservoir area, Tiber Dam, near Chester.
Do	Constructing outdoor-type Helena Valley Pumping Plant of reinforced concrete with a structural steel crane runway and overhead traveling crane, including 2 Government-furnished 150-cubic feet per second hydraulic-turbine-driven pumps. Water for both pumps and turbine comes from Canyon Ferry Reservoir about 500 feet upstream. Near Helena.
Missouri River Basin, Nebr.	Constructing about 9 miles of 635-cubic feet per second capacity earth section and about 8 miles of laterals, including a 10.5-foot monolithic siphon about 800 feet long, culverts, turnouts, checks, drain inlets and orifice structures, overchutes and wasteway. Courtland Canal, Fourth Section, about 3.5 miles south of Webber.
Do	Constructing about 10 miles of unlined and earth-lined canal with a bottom width of 16 feet; about 2 miles of road relocation; and about 3 miles of open drains. Upper Meeker Canal, near Trenton.
Missouri River Basin, N. Dak.	Constructing the 115/69-kilovolt Ellendale Substation will include grading and fencing the site, constructing foundations and a small service building, furnishing and erecting steel structures, and installing electrical equipment, major items of which will be Government-furnished. Near Ellendale.
Missouri River Basin, S. Dak.	Constructing the 115/34.5-kilovolt Yankton Substation will include grading and fencing the site, constructing foundations and a small service building, furnishing and erecting steel structure, and installing electrical equipment, major items of which will be Government-furnished. Near Yankton.
Do	Constructing additions to the Rapid City Substation will include foundations, furnishing and erecting steel structures, and installing 30.5-kilovolt electrical equipment, major items of which will be Government-furnished. Near Rapid City.
Do	Constructing additions to the 115/69-kilovolt Sioux Falls Substation will include foundations, erecting and altering a Government-furnished steel structure, and installing a 115-kilovolt, 75,000-kilovolt-amperes output voltage regulating transformer and associated electrical equipment, major items of which will be Government-furnished. At Sioux Falls.
Do	Furnishing and applying a gravel surface to portions of a recently-constructed county road. Rapid Valley Unit, near Pactola Dam, west of Rapid City.

Project	Description of work or material
Missouri River Basin, S. Dak.-Minn.	One 230-kilovolt, three 115-kilovolt, and one 15-kilovolt power circuit breakers for Granite Falls Substation.
Missouri River Basin, Wyo.	Rehabilitating the 34.5/4.16-kilovolt Cody Substation will include cnstructing foundations, furnishing and erecting steel structures, altering existing structures, and installing electrical equipment, major items of which will be Government-furnished. At Cody.
Do	Furnishing materials and performing work for constructing streets and walks, and installing complete sewage disposal and water distribution systems at Glendo.
Do	Earthwork and structures for 6 miles of CB & Q Railroad. Near Glendo.
Do	Six 7.25- by 7.75-foot outlet gates and hydraulically-operated hoists and handling equipment. Estimated weight: 700,000 pounds. For Glendo Dam.
Do	Furnishing and installing two 13,333-kilovolt-amperes 180-revolutions-per-minute, 0.9 power factor, 6,900-volt, vertical-shaft generators at Glendo Power Plant.
Owyhee, Oreg.	Constructing 1,000 feet of rectangular concrete chute wasteway, 10-foot width, 6 feet high. Ten miles southwest of Dunaway.
Do	Four horizontal, motor-driven, centrifugal-type pumping units, two units each with a capacity of 40 cubic feet per second, one unit with a capacity of 30 cubic feet per second, and one unit with a capacity of 20 cubic feet per second, all at a total head of 120 feet. For the Ontario-Nyssa Pumping Plant.
Palisades, Idaho	Installing nonembedded parts of four 39,500-horsepower turbines, miscellaneous metalwork and electrical equipment in and on Palisades Power Plant; constructing switchyard, including furnishing and erecting structural steel, constructing concrete foundations, installing electrical equipment and piping systems; and completing all other work including furnishing and installing metal swinging doors, metal rolling doors, handrails, interior architectural finishes, steel takeoff structures, electrical and hydraulic apparatus, and heating and ventilating equipment. Near Irwin.
Palisades, Idaho	Three 115-kilovolt potential transformers with two 115-volt secondaries and six 115-kilovolt, 400/800- to 5-ampere current transformers. For Goshen Substation.
Palo Verde, Ariz.-Calif.	Constructing Palo Verde Diversion Dam will include an earthfill embankment across the Colorado River about 1,230 feet in length, a gated concrete spillway structure at the right end of the embankment, a new concrete headworks structure for the Palo Verde canals between the spillway and the right abutment, and 30 miles of levees and drains extending upstream from the left end of the earthfill embankment to protect the lands of the Colorado River Indian Reservation. The existing rock weir will be removed as required to eliminate its effect on control of the river. On Colorado River about 9 miles upstream from Blythe, Calif., by Highway No. 95.
Rogue River, Oreg.	Constructing a 60-inch precast concrete pipe siphon 645 feet long; a reinforced monolithic concrete stilling pool; a reinforced monolithic concrete bench flume 352 feet long; and a 54-inch precast concrete pipe siphon 545 feet long. Main Canal, about 25 miles east of Medford.
Do	Replacing a wood-stave flume with two 42-inch diameter precast concrete pipe siphons, one 100 feet long and the other 700 feet long. Hopkins Canal Siphon, near Medford.
Do	Replacing a 44-inch diameter wood-stave pipe siphon with a 45-inch diameter precast concrete pipe siphon, 1,860 feet long. Medford Canal Siphon, near Medford.
Solano, Calif.	Constructing about 6.2 miles of concrete-lined Putah South Canal with bottom width of 12 feet, including monolithic concrete siphons, checks, overchutes, bridges, and Parshall flume. Five miles south of Winters.
Weber Basin, Utah.	Earthwork and structures for 6.5 miles of precast concrete pipeline including turnouts, manholes, air valves and blow-offs. Davis Aqueduct, between Salt Lake City and Ogden, Utah.
Do	Constructing East Bountiful and South Davis Pumping Plants of 13- and 14-cubic-feet-per-second-capacities, respectively. Each plant will have 4 electric-driven pumps with electric control cubicles and a 5-ton hand-operated bridge crane. The pumping plant structures will be of reinforced block and brick construction with concrete substructures and timber roofs. Work will also include construction of a switchyard adjacent to each pumping plant and furnishing and installing one transformer bank at each plant. At Bountiful.
Yuma Auxiliary, Ariz.	Reshaping, relocating and lining with concrete about 1.5 miles of 100-cubic-feet-per-second-capacity main canal, installing 4 checks with 2 metal slide gates in main canal, constructing from main canal six 15- to 5-cubic-feet-per-second-capacity turnouts, constructing about 2 miles of 25- to 5-cubic-feet-per-second-capacity concrete-lined laterals, constructing about 3 miles of 20- to 5-cubic-feet-per-second-capacity pipe laterals, drops, checks, culverts, and turnouts, repairing existing structures, and installing measuring devices. Near Yuma.
Yakima, Wash.	Constructing 24 miles of 128- to 9-cubic-feet-per-second-capacity laterals and 11 miles of sublaterals, with timber bridges, siphons, turnouts, checks, culverts, and drain inlets. Highlands Feeder Canal and Badger Laterals, 5 miles west of Kennewick.

*Subject to change.

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The Reclamation Era

November 1955

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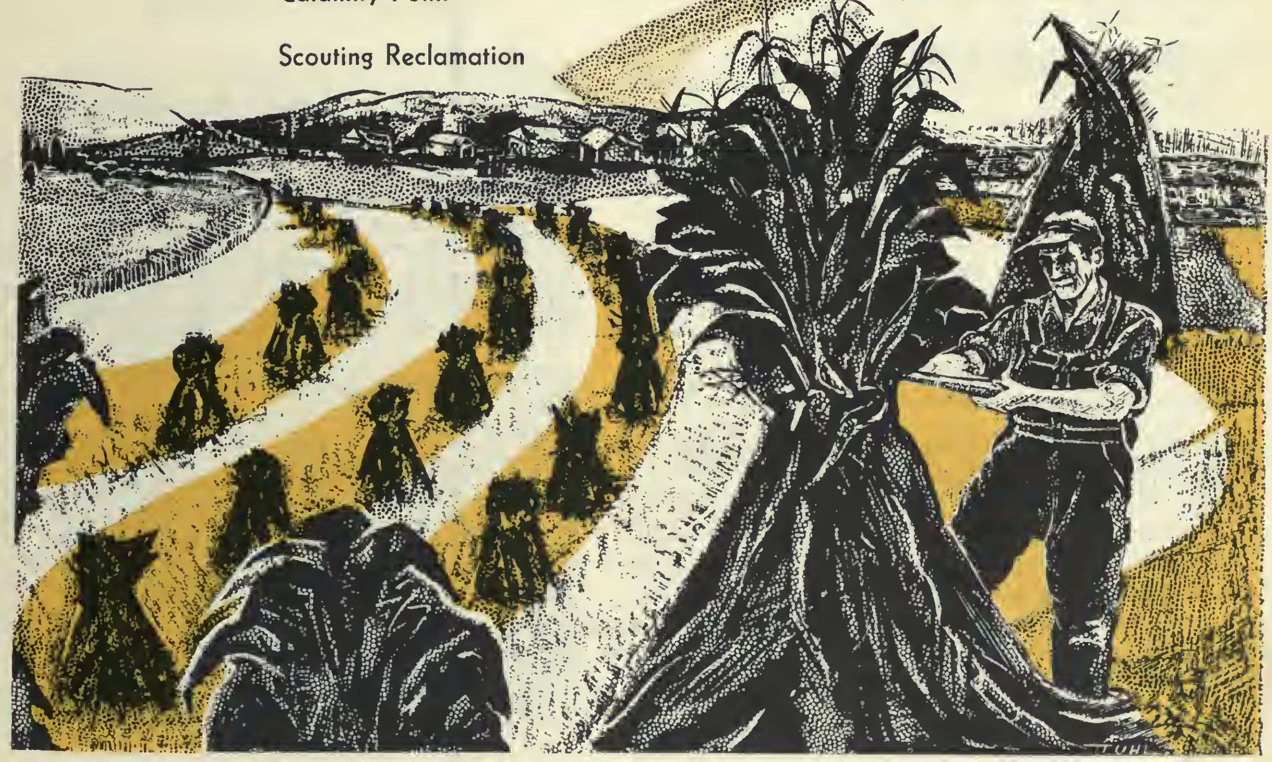

Official Publication of the Bureau of Reclamation

The Reclamation Era

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In this issue . . .

DESIGN AND ILLUSTRATIONS by Drafting and Graphics Branch
Bureau of Reclamation, Washington, D. C.

J. J. McCARTHY, Editor
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* * *

30 Years Ago in the Era

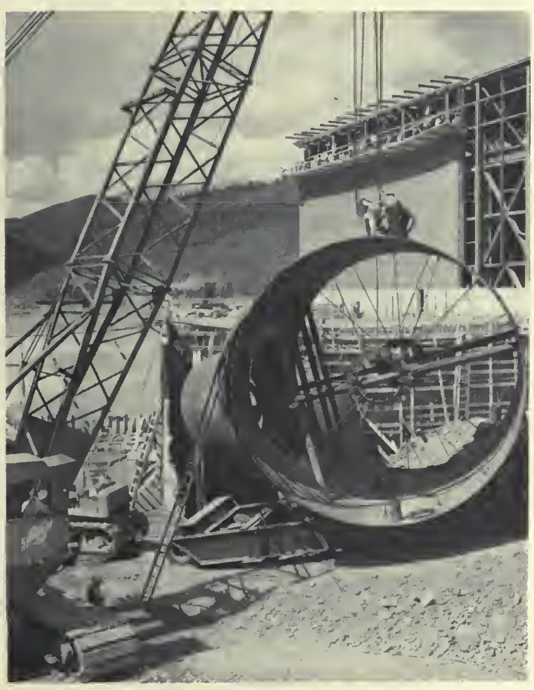
Success in irrigated agriculture and the solvency of reclamation projects depend on selection of settlers, peopling the land with men who have the experience and the skill to grow high-priced crops and to cultivate the land in a way to get large returns. Poor farming, growing of crops that require little skill or care in cultivation, and which bring small returns, characterize most of the projects where payments are not being made.

One of the first conditions in the beginning of new projects is to work out an agricultural program, to determine what kind of crops ought to be grown, and to endeavor to secure settlers who like that kind of agriculture. The beginning of a new project gives an opportunity that ought to be used to make cooperation the basis of its organization, to try and unite the settlers so that they will grow enough of particular crops or produce to enable them to sell at an advantage, and to use teamwork in doing so. Only in this way can the man on 20 or 40 acres do business on equal terms with the farmer on 1,000 acres.

IN THE SHADOW OF CALAMITY POINT

by ROBERT T. FLYNN, Chief Contract Administration Branch, Palisades Project Office, Palisades, Idaho

Above: BIG ELK CREEK FILL. Top right: Site of Palisades project looking upstream. CALAMITY POINT is at right center with dam and powerplant at its base. Below: Bypass manifold section L–1 (26 feet in diameter) will carry water to turbines or divert it through outlet works if necessary. All photos, this article, by Phil Merritt, Region 1.



Let's take a little trip 55 miles up the South Fork of the Snake River from Idaho Falls into the mountains of southeastern Idaho, and see what's happening in the shadow of Calamity Point. The events that are taking place began in 1928 when the American Falls Reservoir on the Minidoka project in Idaho, was completed. That marked the completion of one project and unknowingly the beginning of another; the Palisades Project, the principal structure of which will be the Bureau of Reclamation's largest earthfill dam. Its 13.8 million cubic yards will overshadow in total volume such colossal concrete dams as Hoover and Grand Coulee.

When American Falls Dam was completed it was thought that the storage capacity would fulfill all the needs of lands under irrigation and permit 433,000 acre-feet of space to be reserved for development of new land. However, shortly after 1928, during an unprecedented series of dry years, American Falls Reservoir failed to fill and the large volume of reserved storage was leased to water users on existing projects. Even this failed to provide the water needed and serious crop losses amounting to millions of dollars resulted in 1931 through 1935. Such serious losses revealed the urgent need for additional storage, in order to

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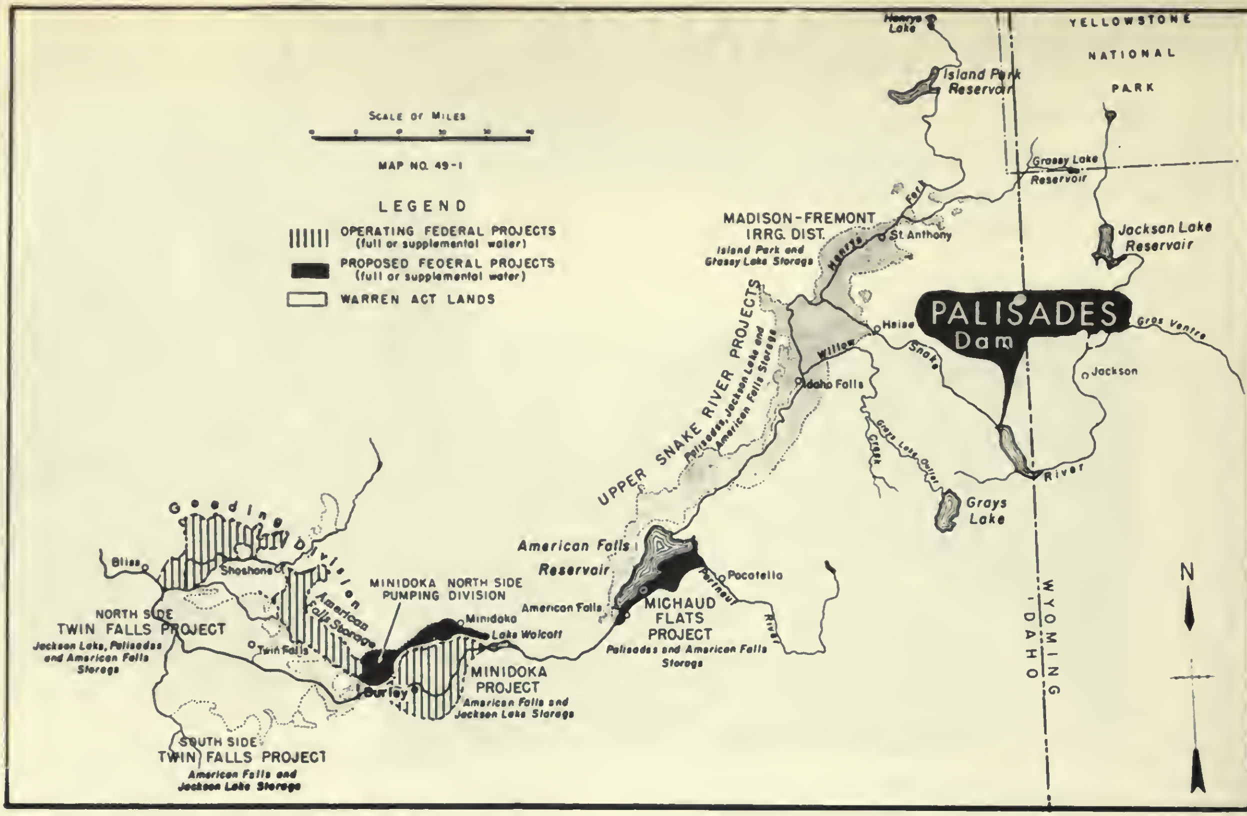


hold over water which was excess in periods of high runoff.

Because of this, the Bureau of Reclamation was directed in 1932 to initiate surveys for possible dam and reservoir sites on the Upper Snake River. Calamity Point was the best site found and this is where it was decided to construct the Palisades Dam.

The project was first authorized in 1941 and was reauthorized in 1950 because of increased costs and changes in operating plans. In October 1951, the project was granted its first substantial appropriation for construction of the Palisades Dam and powerplant and related structures.

The project is a multiple-purpose development involving irrigation, flood control, power, and recreation. Its stored waters will provide for 28,000 acres of new irrigation development and, of prime importance, will provide an adequate supply of water in dry cycles to 650,000 acres of existing highly developed lands in the Upper Snake River Valley, extending from Bliss, Idaho, to a few miles south of Rexburg. It will also provide a substantial degree of flood protection to agricultural and urban areas downstream and significant recreational opportunities to the entire area. A certain amount of water must be passed through the reservoir during the winter months to fill the prior storage rights of American Falls Reservoir and during the spring and summer months water will be released for flood control and irrigation. This will be utilized for production of power for commercial sale and for irrigation pumping.

The current estimated cost of the Palisades Project is 67.3 million dollars. Of this total, 70 percent will be returned to the Federal Treasury in 50 years by the water users and through the sale of power. Power revenues alone will repay about 56 percent of the total cost. Revenues from power will continue to accrue to the United States after the 50-year initial payout period. About 30 percent of the total cost is allocated to flood control, recreation and fish and wildlife, and is nonreimbursable.

The prime contract for the dam and powerplant was awarded April 18, 1952, for 26.6 million dollars to the Palisades Contractors, a joint venture consisting of the J. A. Jones Construction Co. of Charlotte, N. C., and the Chas. H. Thompkins Co. of Washington, D. C. Paul H. Swanson

Continued on page 97

DISABLED DISPLAY ABILITY

In cooperation with the President's Committee on NATIONAL EMPLOY the PHYSICALLY HANDICAPPED week, proclaimed by Hon. Dwight D. Eisenhower October 2–8 we present these typical examples of opportunities the Bureau of Reclamation is offering to handicapped persons.

CHARLES S. WILLFOUNG was employed on the Boulder Canyon project in 1940 as a lineman. Today Charlie continues to work at his trade in the maintenance section at Hoover Dam. He is responsible for the electrical building facilities within the power plant, and for the uninterrupted and continued operation of cranes, compressors, elevators, lighting and power circuits, pumps and the telephone system. He rates with the highest in the performance of this work and is held in high esteem as a journeyman by his fellow workmen.

He entered military service in 1941, and departed for Europe and Africa in 1942. Charlie served through the Tunisian and Italian campaigns, and was awarded two Bronze Campaign Stars and the Purple Heart, for Charlie was wounded in action in 1944. After returning to the United States, Charlie was discharged from the service in 1945.

Upon being discharged, Charlie says he felt perfect but the Army took the view that somehow he was 60 percent disabled, because of the right leg they had been required to amputate below the knee.

In due course, Charlie returned to Hoover Dam, and with an artificial limb continued to perform his old job as effectively and efficiently as in the past.

According to LEO RALPH HOLWAY, totally deaf draftsman in the Assistant Commissioner's office in Denver, Colo., deafness is not a handicap, "It's an obstacle to overcome, and there are many obstacles in the world." His supervisors agree that he has done an excellent job overcoming his particular "obstacle," and that his 21 years with the Bureau have been a wise investment.

Leo became deaf at the age of 5 from spinal meningitis. He received his higher education—culminating in a bachelor's degree in philosophy—from Gallaudet College at Washington, D. C. The signature on his diploma is that of Theodore Roosevelt, the Father of Reclamation, and Leo is justly proud.

He worked as a railroad draftsman until 1934, when he joined the Bureau in Denver. J. J. Smith, Head of the

(A) CHARLES S. WILLFOUNG.
(B) LEO RALPH HOLWAY.
(C) ANDREW F. BRUNER.
(D) BEN PETERSON.
Photo by Lyle C. Axthelm.

Maps, Tracings, and Drawings Section, says he does excellent work, and is cheerful and efficient on the job. His "handicap" affects his work in only one way—he insists on written instructions, although he can read lips and speaks quite well. This is to insure that he doesn't miss important points in verbal instructions.

"On the other hand," says L. D. Brown, Assistant Head of the Section, "misunderstandings don't last long with Leo—he just pulls out his notebook and shows us what we told him to do, and he's almost always right."

ANDREW F. BRUNER is employed as irrigation operator (watermaster) on the Tule Lake Division, Klamath project. Bruner is a veteran of World War II and lost his left arm while serving overseas. He is a very capable employee and his physical handicap in no way affects the efficiency of his work. He has been employed by the Bureau on the Klamath project since 1946.

The operation of the Tule Lake Division requires the constant handling of heavy equipment such as draglines, dump trucks, bulldozers, etc. In this capacity Bruner measures up to the rest of the employees, if not excels them in most respects.

He not only is capable but one of the most reliable employees on the job. When the going is roughest, especially in an emergency, the byword is "we can always count on Bruner."

BEN PETERSON is a handicapped farmer who lives near Orleans, Nebr., in the Frenchman-Cambridge Irrigation District. He is 65 years of age and operates a 220-acre farm, of which 135 acres are under cultivation. In August 1954, irrigation service from the Cambridge Canal was provided for 35 acres of this land. He also has irrigated 50 additional acres by pumping for a number of years.

Peterson lost his right hand in 1922 while cutting wood with a buzz saw. Since that time, he has continued to do his farm work with the help of his wife and two children who are now grown. He learned to use his left hand and even mastered the technique of hand shucking corn.

Peterson's farming operations now consist largely of the production of corn and alfalfa, but at one time he specialized in the production of turkeys and grew potatoes commercially.

HARRY S. POWERS is employed as an engineering aid (Survey) by the Missouri-Souris projects with headquarters in Bismarck, N. Dak.

Mr. Powers first entered Bureau employment in January 1946 as an engineering aid for what is now the Yellowstone Bighorn projects office and was headquartered in Miles City, Mont. He held various positions on surveys there until his resignation in October 1949 to go into farming for himself.

Between October 1949 and September 1952 when he accepted employment as an instrumentman with the Missouri-Souris projects, Powers was involved in a farm accident. His left forearm was caught in a cornpicker making amputation necessary 5½ inches below the elbow. He is naturally right-handed and with the aid of a mechanical device worn on his left arm he has successfully overcome his handicap.

He is an experienced and capable transitman, levelman and planetableman. His work is above average from both the standpoint of accuracy and neatness.

HOWELL P. HUGHES, a disabled veteran, has served in the Santa Barbara area projects office, Goleta, Calif., for the past 6 years.

Continued on page 100

HARRY S. POWERS—*Albert Helstrom Photo.*

HOWELL P. HUGHES.

CHARLES CURRY.

WATER REPORT

by HOMER J. STOCKWELL
Snow Survey Leader, Colorado Experiment Station, Fort Collins, Colo.
and
GREGORY E. PEARSON
Snow Survey Leader, Soil Conservation Service, Salt Lake City, Utah

BOGUS BASIN, BOISE PROJECT, IDAHO
Photo by Phil Merritt, Regio 1.

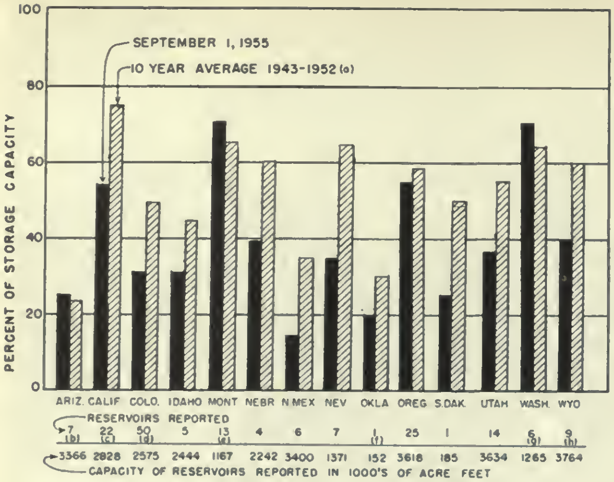
Irrigation water supply over much of the Western United States in 1955 was short of that required to meet demands. Last April, this was indicated by the lack of snow in the high mountains. The only exception to the low water supply outlook at that time was in northern Montana, Idaho, the State of Washington, and along the coastal range in Oregon. The general pattern of 1955 water supply closely followed the spring forecasts based principally on the mountain snow pack. A brief westwide summary of snow conditions was published in the May 1955 issue of RECLAMATION ERA.

Above normal rainfall tended to relieve the water shortage in isolated areas of the southwest including the southern Rocky Mountain region. Total water supply was well below normal but better than in 1954. A main flood occurred on the Arkansas watershed in Colorado which improved water supply conditions in extreme eastern Colorado and western Kansas. Along the Rio Grande in New Mexico the water supply continued to be poor. Crops are being produced by the increased use of groundwater resources. Heavy storms in late summer has substantially increased storage in the reservoirs of the Salt and Gila drainage in Arizona following a period of extremely low snowmelt runoff. Streamflow in California was 68 percent of average in the state for the summer months. No general shortages of water were reported for snow melt streams but much of the carryover storage was used. In 22 major reservoirs in California the carryover storage is 54 percent of capacity as compared to an average of 75 percent for September 1.

Severe water shortages were experienced in central and southern Utah. Similar shortages are reported for tributaries to the Snake River in southern Idaho and eastern Oregon. Water supply along the Humboldt River in Nevada has been critical throughout the summer season.

In Montana, northern Idaho and Washington water supplies were adequate for all purposes except in scattered locations.

The flow of the Colorado River into Lake Mead (April-July) was only about one-half of the past 10-year normal and just 1 million acre-feet greater than for the same period in 1954. Approximately 92,000,000 acre-feet flowed in the Columbia River by The Dalles for the period April 1 through August 31, or 90 percent of normal. There was a wide range in flow of streams over the Columbia Basin.



NOTES FOR RESERVOIR STORAGE CHART

Reservoir storage as of September 1, 1955. Explanation: (a) Most State averages for reported reservoirs are for a full 10-year period, but in a few cases reservoirs with shorter records have been included. (b) Does not include Lake Mead, Havasu, or Mohave (combined capacity 30,433,000 acre-feet); September 1, 1955 combined storage 14,912,000 acre-feet. (c) Does not include Shasta, Folsom, Vermilion, Millerton, Pine Flat, or Isabella Reservoirs (combined capacity 7,148,600 acre-feet); September 1, 1955, combined storage 3,286,180 acre-feet. (d) Does not include John Martin Reservoir (capacity 655,000 acre-feet); September 1, 1955, storage 127,000 acre-feet. (e) Does not include Fort Peck Reservoir (capacity 19,000,000 acre-feet); September 1, 1955, storage 7,166,000 acre-feet; or Canyon Ferry (capacity 2,043,000 acre-feet); September 1, 1955, storage 1,945,000 acre-feet; or Flathead Lake (capacity 1,791,000 acre-feet); September 1, 1955, storage 1,740,000 acre-feet; or Hungry Horse (capacity 3,500,000 acre-feet); September 1, 1955, storage 3,427,000 acre-feet. (f) W. C. Austin Reservoir. (g) Does not include Roosevelt Lake (capacity 5,072,000 acre-feet); September 1, 1955, storage 5,150,000 acre-feet. (h) Does not include Boysen Reservoir (capacity 758,000 acre-feet); September 1, 1955, storage 249,000 acre-feet.

Looking forward to the next water-year, western water users will need a heavy snow pack in the mountains. Even where water supply this year was reasonably adequate water in storage has been seriously reduced. In this year's water short areas increased stream flow will be essential for 1956 needs, and to replenish the surface and groundwater reservoirs.

In the following paragraphs there is reported a summary of fall water conditions by States. These reports are supplied by the Snow Survey Leaders, Soil Conservation Service for all Western States except California. Information on the status of water supplies in California is furnished by the California State Division of Water Resources.

ARIZONA.—Unusually heavy summer precipitation in Arizona resulted in marked improvement in the outlook for future runoff and produced substantial increases in current water supplies. Mountain drainage areas have been thoroughly saturated and deficient stream flows of the early summer replaced by adequate flows to meet all current gravity-flow demands. Reservoir storage has improved greatly both from direct runoff and from reduced demand resulting from rainfall in sufficient quantities to replace irrigation needs. On the Salt River project the overall gain from both sources amounted to almost a quarter million acre-feet and it now appears that there may be a substantial carryover into next season. Early season prospects were for practically empty reservoirs by this fall with only normal summer precipitation.

Conditions on the Beardsley project are much the same, with a total benefit from the summer storms of some 20,000 acre-feet at Lake Pleasant. San Carlos Reservoir on the Gila River had its apparent peak on September 1, with about 109,000 acre-feet in storage compared with a water surface below the outlet gates on July 12. There was very little water in storage in this reservoir early in the season and the project water supply was consequently quite deficient in contrast with most other Arizona areas.

Soil moisture conditions in the moutnain areas are so improved as a result of the summer storms that deficient stream flows have been replaced by normal or near-normal sustained flows which promise to hold up well through the fall season. With normal fall rains, mountain soil-moisture contents should remain at a high level and provide conditions more favorable for spring runoff than have existed for the past few years.

CALIFORNIA.—The California Division of Water Resources forecasted on April 1 that the April–July snowmelt runoff during 1955 for the Central Valley streams would be approximately 58 percent of normal assuming the occurrence of normal precipitation during the runoff period. However, April precipitation ranged between 100 and 200 percent of normal, and after individual stream forecasts had been adjusted according to local precipitation patterns, the revised forecast of May 1 indicated that the total runoff would be about 66 percent of normal. May precipitation was near normal and no adjustment of the revised forecast was made on June 1. The total snowmelt runoff, based upon preliminary records, proved to be 68 percent of normal and therefore the revised forecast was low by approximately 2 percent.

As of September 1, 1955, there were 4,812,810 acre-feet of water stored in the 29 major reservoirs serving the Central Valley. This is about 72 percent of normal supply for that date and is 523,000 acre-feet less than that in storage on September 1, 1954. The below normal storage is directly attributable to the deficent (68-percent normal) April–July runoff during the 1955 season.

COLORADO.—Water supply for irrigation in Colorado was short in 1955 but the shortage was not nearly as severe as in 1954. Rainfall during the summer months was variable and in scattered areas over the State rainfall was much above normal. Excessive floods occurred along the Arkansas River and its southern tributaries in May. Over 200,000 acre-feet was accumulated in John Martin Reservoir as a result of this flood.

On the South Platte water supplies were generally adequate in the area served by the Colorado Big Thompson project. A little more water was left over than anticipated. More severe shortages occurred on agricultural lands on Clear Creek, the Upper South Platte near Denver and on low priority canals without storage near Fort Morgan and Sterling.

Because of the May flood the irrigated area along the Arkansas River below John Martin Dam had adequate water supplies; but over most of the valley in Colorado water shortage was general. The flood destroyed canals and diversion structures so little water was stored during this period. Firm flow of the stream as a result of snowmelt was low. Water supply for different canals varied in direct relation to flood damage and subsequent summer plains rainfall.

Summer stream flow was again below normal on the Rio Grande in Colorado. Further development of pumping and reduction in crop acreage have occurred this past summer. Flow from the Sangre de Cristo Range was above average due to the May storm which centered just east of this range in the Arkansas Valley.

On the western slope, streamflow from snowmelt was only 60 percent of average. Late summer rainfall has kept stream flow relatively high and has reduced water demand. Water shortage has existed only on minor tributary streams.

Continued on page 95

"SAUSAGE PLANT." Raw material on left. Finished product on right.

SAUSAGES ALL SIZES. This photo shows three dimensions.
All photos courtesy Regio 4.

"Sausages" for Erosion Control

by PARLEY R. NEELEY, Area Engineer, Spanish Fork, Utah

Sausages generally bring to the mind a stack of steaming hot flapjacks and the usual breakfast trimmings. This is not, however, the scene that prevails in the Spanish Fork Development Office when the term is mentioned. Confronted with a problem of obtaining riprap in an area where Mancos and Uintah shales prevail and suitable rock is a minimum of 50 miles distant, a substitute was devised and named "sausages."

The highway department in processing road surfacing gravel had left behind large piles of quartzite cobbles in the near proximity of the work where riprap was needed. The cobbles ranged in size from 4 to about 12 inches in diameter and were not considered suitable material for the type of riprapping required until the idea was developed to confine the cobbles in a wire mesh, making rock "sausages."

When the cobbles were confined in the wire mesh the unit provided many advantages. The combination of confined cobbles made a heavy unit which acts as one large compact piece, the eddies set up by the irregular surface tend to attract deposition of silt, the unit is flexible and settles snuggly into the soft sandy foundation. The unit was easily handled with a dragline by hooking into the wire mesh, lifting and placing in position and their uniform size made a closely knit compact surface resistant to erosion or shifting.

The unit was constructed by taking a piece of 32-inch hog wire fencing 10 feet long, folding and then lacing the two edges together with wire. The result was a cage about 3½ feet long, 20 inches in diameter which, when standing up, had a closed bottom and open top. The wire cage was filled with cobbles, the top laced together and was then ready for placing.

The cost of preparing and placing the unit was less than two-thirds of the estimate for quarried rock riprap had such a quarry been in the near proximity of the work. The cost of the unit compared with an estimated cost of riprap with quarried rock from the minimum distance available, about 50 miles, would be less than one-third.

The accompanying photographs represent one of the many uses which can be made of the "sausages." In this case erosion had approached the canal bank, leaving only a narrow bank between the river and the canal and there was no

right-of-way to force the river channel away from the eroded section. Treated native timber piling was driven and timbers spiked horizontally between the piling. The "sausages" were stood on end for two rows high then continued on the sloped bank. # # #

SWINGING SAUSAGES into place. Sausages in place are the second high tier. Next view shows placing second and third tiers of sausages. At bottom, COMPLETED JOB.

PRIVATE FIRMS DO PRACTICALLY ALL RECLAMATION CONSTRUCTION

During the fiscal year of 1955 private contractors, through competitive bidding, performed practically all Reclamation construction.

Only 1 percent of construction monies was spent during the year for work performed by hired labor. Out of a total construction expenditure of $117,978,000 only $1,285,000 was spent for construction work done by Bureau forces. This marked a new all low in work done by Bureau forces. There has been a gradual decrease in hired labor work by the Bureau since the war years, Reclamation Commissioner W. A. Dexheimer pointed out. He also stressed the fact that it is the Bureau's policy to award all contracts to private firms on the basis of the lowest competitive bid.

Only where shortage of time, character of work, emergency situations, or other special conditions exist which make it impossible to secure satisfactory bids, do Bureau forces undertake construction work. #

CROPS UP $79.1 MILLION

Crops valued at $865 million and weighing 26.6 million tons were produced on Reclamation's 69 projects during 1954. The crops had an average gross value of $141.21 per acre and represented an increase over 1953 of $79.1 million in total gross value.

Over 100,00 acres of irrigable land were brought into service on Bureau projects during 1954 as a result of the completion of irrigation facilities. Principal additions were on the Central Valley, Columbia Basin, Gila, Minidoka, and Missouri River Basin projects.

The volume for all principal crops except cotton, wheat, and vegetables was higher in 1954 than 1953. Among those in the plus column were fruits and nuts, miscellaneous field crops, forage, cereals, and seeds.

Prices received for the products of irrigation farming were on the whole equal to or higher than in 1953 with a greater total value reported for all crop groups except field crops consisting principally of sugar beets, cotton, and dry edible beans.

The Crop Report and detailed Statistical Appendix on crop production on Reclamation irrigation projects are available to interested persons. Copies may be obtained by writing to your nearest regional director or the Commissioner's office in Washington, D. C. #

Reclamation's HALL OF FAME NOMINATION NO. 19

Howard E. Robbins

On September 15, 1954, Howard E. Robbins was laid to rest in Fairmount Cemetery in Denver, Colo. With the death of Mr. Robbins at the age of 58 the Bureau of Reclamation lost one of its top administrators, but the people throughout Region 5 lost a friend and leader.

At the time of his passing, Howard Robbins was regional director of Region 5 with headquarters in Amarillo, Tex. In dollars, Reclamation's program in Region 5 is not one of the largest nor most impressive, but with the wide geographic area covered and its corresponding complex problems involving intrastate basin, and interstate and international streams, the program is varied and presents many difficulties in any effort to harness the vast natural resources of the region.

Born in Denver, Colo., Mr. Robbins attended Colorado College until he joined the Bureau of Reclamation at Grand Junction, Colo., on the Grand Valley project in 1916. This assignment was interrupted for one year while he served with the United States Army during World War I. He was promoted through the positions of instrumentman and junior engineer in the investigations of the King Hill project in Idaho and the Klamath project in southern Oregon and northern California. He left the Bureau in 1925 to accept a position with the California-Oregon Power Co. with headquarters at Medford, Oreg., in order to broaden his engineering experience. During his 4 years with this company, he was in charge of surveys required for locating transmission lines and topographic and investigation surveys.

He returned to the Bureau in 1929 to work on investigations of the Kendrick project on the North Platte River in Wyoming. In the meantime, from 1930 until 1936, as an engineer in the Design Section of the Chief Engineer's office in Denver, he assisted in the designs for Boulder Dam, prepared layout and final designs for laterals, tunnels, and other structures on the All-American Canal, and designed dams and appurtenant structures for TVA, which work was being performed by the Chief Engineer's office of the Bureau of Reclamation. In 1936, he transferred to Phoenix as office engineer on the Salt River project during the construction of Bartlett Dam, a 287-foot high, concrete, multiple arch structure on the Verde River. Upon its completion during the latter part of 1937, he transferred as office engineer for the construction of Seminole Dam and powerplant on the Kendrick project, and in 1939 to the Colorado-Big Thompson project for construction of Green Mountain Dam.

In 1941 transferring to Altus, Okla., immediately following the authorization of construction of the W. C. Austin project, Mr. Robbins saw its construction from its initiation through to final completion as Regional Director, in 1953. He made the first delivery of water on July 19, 1946. This project, constructed in a semiarid region, had been investigated as early as 1912 and was finally approved by the President on January 21, 1941.

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Construction was halted in December 1942, by World War II, but with the recommendation of the War Food Administration, construction was resumed in April 1944. As construction engineer, Mr. Robbins faced many difficult and trying experiences in getting the work underway with the material and labor shortages and the complicated priority system. When major construction was completed on the W. C. Austin project in 1947, he transferred as project engineer to the Valley Gravity project, for which plans were being developed to provide drainage and improve water transportation facilities for the lands of the Lower Rio Grande Valley in Texas, using the water supply to be made available through the construction of international dams on the Rio Grande under the auspices of the International Boundary and Water Commission. Later that year when it became necessary to appoint a regional director and it had become evident that plans for the Valley Gravity project could not materialize for several years, Mr. Robbins was transferred to Amarillo as acting regional director until March 1948, when he became regional director. On this appointment, the Secretary of the Interior said, "Mr. Robbins brings to his new post a sound background in Reclamation engineering and natural resource development. He typifies the kind of public servant under which Reclamation has achieved outstanding success in the control and development of western water and related resources."

While director in Region 5, Mr. Robbins saw the completion of construction of the Tucumcari, W. C. Austin, and Fort Sumner projects; completion of construction of Platoro Dam of the San Luis Valley project, retention dams and extension of the power distribution system of the Rio Grande project and the emergency channelization work on the Middle Rio Grande project, initiation of rehabilitation work on the Vermejo project and the drainage construction of the Middle Rio Grande project; and the operation and maintenance of the Tucumcari, W. C. Austin, and Carlsbad projects turned over to the water users. In addition to these physical works, the investigations program in Region 5 included the development of plans for the Middle Rio Grande, Canadian River, Washita, Gulf Basin, San Luis Valley, and San Juan-Chama projects as well as many basin and minor project investigations.

Succumbing rapidly to the fatal disease, multiple myeloma, Mr. Robbins passed away on September 12 at Mayo Clinic, Rochester, Minn. Friends and associates have contributed approximately $1,000 to the American Cancer Society for a fund in his memory. He is survived by his widow; two daughters, Mrs. Jack L. Hitt and Mrs. John Mulvihill; two granddaughters, Amy Elizabeth and Jane Ellen Hitt; and his parents, Mr. and Mrs. B. W. Robbins.

Mr. Robbins was held in high esteem for his integrity and professional competence. The people in the region concerned with conservation of their limited water supply for full development of their great resources feel keenly the loss of his strong counsel and guidance. The Canadian River Municipal Water Authority of Texas expressed this in its memorial resolution which states *his untimely death deprived our Nation of one of its great engineers and valuable citizens.* # # #

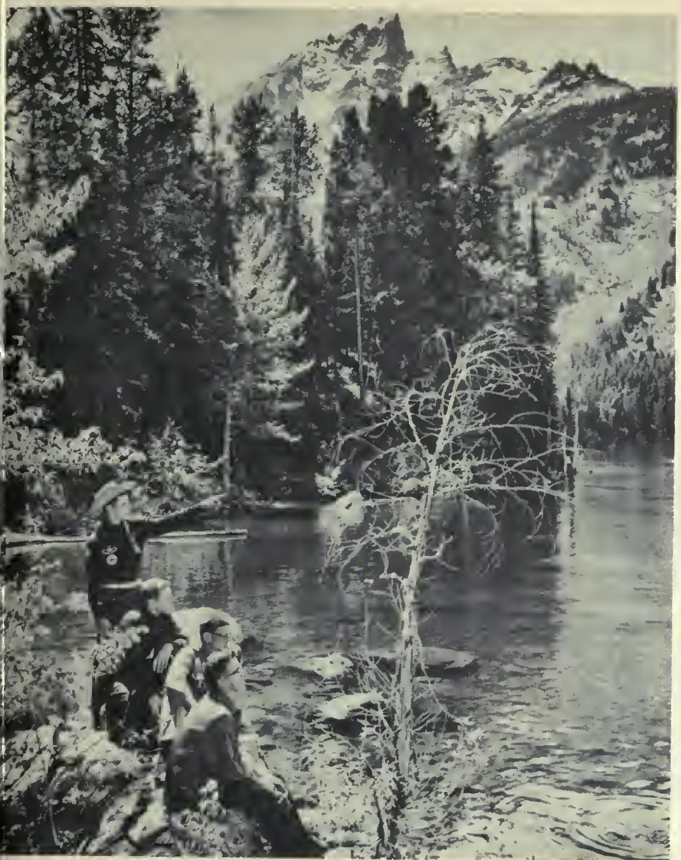
COMMISSIONER DEXHEIMER DEDICATES EKLUTNA PROJECT

On August 29, Reclamation Commissioner W. A. Dexheimer dedicated the Bureau's Eklutna power project located in south central Alaska. A large number of city officials and many interested individuals from Achorage and Palmer areas attended dedication ceremonies. In his address the Commissioner speculated that the future population of Alaska could reach 5,000,000 when the waters of Alaska are harnessed to produce needed power with which Acting District Manager Roberts agreed.

The Eklutna powerhouse is located near mile 34 on the Glenn Highway. Eklutna Creek water is stored and used for the generation of power. Water supply for the power is obtained from the Eklutna Creek Basin above Eklutna Dam, covering an area of 119 square miles with elevations ranging from 867.5 to 8,000 feet.

Early this year power went into the lines to the power markets to the Matanuska Electric Association (5,000 kilowatts); Chugach Electric Association (9,000 kilowatts); and the city of Anchorage (16,000 kilowatts). The plant consists of two 15,000-kilowatt vertical shaft-type generators, each driven by a 21,000 horsepower reaction turbine. The average output is 143,000,000 kilowatt-hours of firm power and 20,000,000 kilowatt-hours of nonfirm power annually.

Other speakers at the dedication were Mrs. Justine Parks, president of the Alaska Rural Electric Cooperative Association; Donald S. Campbell, Chief of the Division of Power, Bureau of Reclamation, Washington, D. C.; Mayor Charles W. Wilson, Palmer; Mayor Maynard L. Taylor, Jr., Anchorage; and Maj. Gen. James F. Collins, Commanding General, United States Army, Alaska. #



THE TOWERING TETONS *as seen from the shore of Jenny Lake, Grand Teton National Forest. All photos by Charles Knell, Region 6.*

SCOUTING CONSERVATION

by
Ottis Peterson

> Editor's Note: Mr. Peterson, Assistant to the Commissioner, Information, participated in the National Boy Scout Conservation Tour as a member of the arrangements committee.

Twelve Explorer Scouts—one from each Boy Scout region in the United States and each a conservationist in his own right—took a look at the Nation's stewardship of publicly owned resources last summer. They all reached the same general conclusions:

1. We, individually, and as a Nation, are dependent upon our natural resources to a large degree for our economic strength and prosperity.
2. Our natural resources, rich as they are, are not inexhaustible and must be wisely used.
3. There is a close interrelationship between our natural resources and conservation and utilization must be considered on a broad, integrated base.
4. Water is the catalyst. The manner in which it is controlled and used determines, to a large degree, the contribution other natural resources make in our daily lives. By the same reasoning, proper use of other resources is important in proper development of our water supply.

The Explorer Scouts, each of whom had received a national award for outstanding work in conservation, participated in a 2-week 2,500-mile tour sponsored by the Departments of the Interior and Agriculture with the cooperation of the Department of Defense.

The tour started at Colorado Springs to which point the youths were provided transportation on Air Force planes from their homes. The first leg of the trip from Colorado Springs was also by air as the boys flow down the Arkansas River over the Dust Bowl area of eastern Colorado, then back up the Arkansas, over the Continental Divide and across the upper Colorado River Basin to Salt Lake City.

En route, technicians from various bureaus within the two departments explained various aspects of conservation work for which they are responsible until the party had a true, bird's eye view of conservation. They saw, in the Dust Bowl area, what lack of moisture and wind erosion can do to prairie land. Flying up the river,

A. AIRBORNE SUPPLIES dropped to Scout camp at Togwotee Pass. B. Receiving first supplies. C. Trying their luck in Yellowstone Lake. D. PROOF POSITIVE. E. One of the Wonders of Yellowstone. F. SHOOTING THE FALLS. G. THE FISH FRY. H. Getting the details on Palisades Dam from Reclamation Engineer Phil Young, extreme left.

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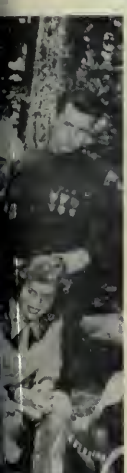

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they could see the difference irrigation water makes with lush green fields on the downstream side of silvery canals as contrasted with parched dry land on the high side.

In Bingham, Utah, on a ground trip, they learned how modern technology and efficiency are making possible the production of copper from the low-grade ore of the Utah copper pit. The same afternoon they learned on the high reaches of the Wasatch National Forest how water production and control is one of the principal benefits of proper forest range management.

In a motor caravan to Ogden Bay Game Refuge, they saw an amazing array of wildlife hidden in a quiet fresh water refuge which was created by diking off a portion of the Great Salt Lake to permit it to freshen from the mountain streams pouring out of the Wasatch Range.

Taking to the air again, the youths headed north over the rich Snake River plain where they saw again the wonders worked by the proper use of water in the several million acres of farmland on the middle and upper Snake River Valley. Before landing, they flew on into Montana to see the Red Rock Lakes Refuge for trumpeter swans and then south over the Yellowstone and Grand Teton National Parks to land at Pocatello, Idaho.

At the Fort Hall Indian Reservation near Pocatello they learned how the Indians are managing their farmlands and maintaining their productivity by proper land management and use of water.

At the upper end of the Snake River Valley, the next day, they saw how farm youths, through the 4–H Clubs, are learning to apply science to farming and homemaking. As they entered the Snake River Canyon, they stopped at the headgates of the several canals fed by the Snake River, amazed at the quantities of water which are taken out of the river for irrigation purposes.

Then, just above the quiet country community of Swan Lake, they saw, first hand, construction work on one of the several multiple-purpose dams which make the irrigation of the Snake River plain possible. This was Palisades Dam which is now under construction by the Bureau of Reclamation.

They learned too the plans the Forest Service and sportsmen's organizations have to develop the Palisades Reservoir as another ideal camping and

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Below: MIGHTY TETONS seen by Lee Talbert through vista window at Church of the Transfiguration, Moose, Wyo. Below right: Scouts meet the Reverend W. A. Thomas, pastor of the church. They are l. to r. Charles Braun, Rapid City, S. Dak.; Larry Hutchinson, Thornton, Pa.; Lowell Gillem, Kalamazoo, Mich.; David Gerwitz, Williamsville, N. Y.; Robbie Langley, Milton-Freewater, Oreg.; Paul Wellerford, Paducah, Ky.; the Reverend W. A. Thomas; Lee Talbert, Taft, Calif.; James Noblin, Forest, Miss.; Robert Moore, Raleigh, N. C.; Bob Pilvanis, Branford, Conn.; John Cookerly, Fort Worth, Tex,; and Bruce Bent, Denver, Colo. At right: Lowell Gillem en route to top of Snow King Mountain on ski lift at Jackson, Wyo.

WATER SUPPLY

Continued from page 86

IDAHO.—The water shortages forecast in April as a result of the light snowpack for southern Idaho did not become apparent until July because of spring rains. However, stored water in small reservoirs was slightly less than forecast as the dry soils on the watersheds absorbed an unusually large amount of snow-water and rainfall.

Idaho experienced a cool moist spring which caused high water on the big northern rivers and eased the water shortage in the southern half of the State. The light snowpack of southern Idaho made irrigation water short on streams without adequate reservoir storage. The heavy rains which occurred during April and May did not contribute materially to streamflow because of the dry soils on the watersheds, although the rains in the valleys eliminated 2 or 3 irrigations which saved stored water for later use. Most small irrigation reservoirs in the southern half of the State were empty on August 31 or lower than they have been at that time since constructed. Large irrigation reservoirs are also very low for this time of the year. The 1955 snowfall and spring rains will be the only water available next year and special plans are being made to evaluate the snowpack early in the season and at more frequent intervals.

The Kootenai River in northern Idaho had a slightly above normal snowpack which did not start to melt until late in the season. The moderate flood threat forecast in May materialized near the middle of June, but did not cause serious damage.

KANSAS.—Because of floodwaters stored in John Martin Reservoir in Colorado the water supply along the Arkansas River in western Kansas has been adequate this past summer. Rainfall during the past few months has greatly improved dry-land and range conditions.

MONTANA.—Although the northern Rocky Mountain snowpack in Montana for 1955 was slightly below average, the May and June precipitation was sufficiently above average to maintain median streamflow and supplement irrigation demands.

Reservoir storage has held up well and there are only a few local areas where irrigation water demands have exceeded the supply.

Dry-land crops have thrived on the late spring rains and a bumper crop of wheat, oats, barley is anticipated.

NEBRASKA.—The smaller reservoirs in the Kansas River Basin are standing at 80 percent of the storage of one year ago. Kingsley and Sutherland Reservoirs now hold about 850,000 acre-feet as compared to a past 10-year average of 1,300,000 acre-feet.

The North Platte storage in Wyoming is at 56 percent of the 1943–52 average. Precipitation during July and August has ranged from light to moderate with a resulting deficiency in soil moisture. Snow cover on the North Platte watershed in Colorado and Wyoming next winter must indicate a snowmelt runoff much above normal or the areas under this river system will face a critical shortage of water next season.

NEVADA.—In the western farming and ranching areas of Nevada, agricultural operations were carried out this past summer on a near normal level in spite of limited water supplies. Because the operators were informed of their limited water supply early in the spring, acreages of high water using crops such as potatoes and onions were reduced. By intelligent use of their water supply during irrigation season, per acre yield was higher than usual this year. Reservoirs of the Walker River irrigation district will be empty by the latter part of September. Carryover storage of other Sierra-Mountain watershed reservoirs is below normal.

Along the Humboldt River, the water supply has been critical all season. Lovelock Valley, which in normal years has three cuttings of alfalfa, cut only the first crop on most of the land. Paradise Valley gets its water from the Santa Rosa Mountains but this year the spring runoff was poor. The Humboldt River at Palisade flowed 47,000 acre-feet from April through July. This is only 17.5 percent of normal.

All reservoirs in the State are much below their 1943–52, 10-year averages. Rye Patch Reservoir on the Humboldt River, serving the Lovelock Valley, was emptied during August. This is the first time this reservoir has been empty since construction was completed in early 1936.

Topaz and Bridgeport Reservoirs on the Walker River are expected to be dry by the latter part of September. The last time these reservoirs were at this low level was the fall of 1930 and 1931. The statewide picture of reservoir storage as of September 1 is only 35 percent of capacity. Last year at this time reservoir storage was 53 percent of capacity. In short, reservoir carryover storage in Nevada will be practically nil.

NEW MEXICO.—Drouth conditions continued along the Rio Grande in New Mexico in 1955. Streamflow was about 40 percent of normal. Crop production was again

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Water Stored in Western Reservoirs

Operated by Bureau of Reclamation or Water Users except as noted

Location	Project	Reservoir	Storage (in acre-feet)		
			Active capacity	Aug. 31, 1954	Aug. 31, 1955
Region 1	Baker	Thief Valley	17,400	5,000	(1)
	Bitter Root	Lake Como	34,800	13,500	13,400
	Boise	Anderson Ranch	423,200	365,500	289,600
		Arrowrock	286,600	101,000	45,600
		Cascade	654,100	228,900	232,800
		Deadwood	161,900	107,600	86,200
		Lake Lowell	169,000	48,800	10,300
	Burnt River	Unity	25,200	8,000	400
	Columbia Basin	F. D. Roosevelt	5,220,000	5,072,000	5,158,000
		Equalizing	761,800	760,800	638,900
		Potholes	513,000	46,000	93,600
	Deschutes	Crane Prairie	55,300	79,000	19,000
		Wickiup	187,300	46,000	23,000
	Hungry Horse	Hungry Horse	2,982,000	2,979,200	2,980,400
	Minidoka	American Falls	1,700,000	884,900	557,100
		Grassy Lake	15,200	11,700	11,200
		Island Park	127,200	76,500	49,700
		Jackson Lake	847,000	506,300	358,700
		Lake Walcott	80,000	93,600	96,600
	Ochoco	Ochoco	47,500	25,000	6,500
	Okanogan	Conconully	13,000	(1)	8,700
		Salmon Lake	10,500	(1)	10,200
	Owyhee	Owyhee	715,000	188,000	116,900

[1] Not reported.

Water Stored in Western Reservoirs—Continued

Location	Project	Reservoir	Storage (in acre-feet)		
			Active capacity	Aug. 31, 1954	Aug. 31, 1955
Region 1	Umatilla	Cold Springs	50,000	10,100	14,600
		McKay	73,800	13,800	17,400
	Vale	Agency Valley	60,000	14,600	0
		Warm Springs	191,000	35,400	0
	Yakima	Bumping Lake	33,700	22,700	14,400
		Cle Elum	436,900	343,400	307,500
		Kachess	239,000	180,100	183,900
		Keechelus	157,800	115,900	102,400
		Tieton	198,000	159,100	143,500
Region 2	Central Valley	Folsom	920,300	0	142,000
		Keswick	23,800	19,300	19,200
		Lake Natoma	8,800	0	0
		Millerton Lake	500,000	163,700	110,800
		Shasta	4,374,100	3,167,800	2,168,200
		Vermillion	125,100	0	51,700
	Klamath	Clear Lake	513,300	241,700	5,300
		Gerber	94,300	36,200	10,700
		Upper Klamath Lake	524,800	278,200	228,900
	Orland	East Park	47,900	13,300	4,200
		Stony Gorge	50,000	18,600	13,300
Region 3	Boulder Canyon	Lake Mead	27,207,000	14,294,000	12,490,000
	Davis Dam	Lake Mohave	1,809,800	1,522,200	1,351,000
	Parker Dam Power	Havasu Lake	688,000	632,300	618,000
	Salt River	Bartlett	179,500	30,000	11,000
		Horse Mesa	245,100	213,000	230,000
		Horseshoe	142,800	1,000	65,000
		Mormon Flat	57,900	55,000	57,000
		Roosevelt	1,381,600	589,000	306,000
		Stewart Mountain	69,800	59,000	57,000
Region 4	Eden	Big Sandy	35,000	9,300	7,600
	Fruitgrowers	Fruitgrowers	4,500	300	700
	Humboldt	Rye Patch	179,000	1,100	200
	Hyrum	Hyrum	15,300	2,600	4,900
	Mancos	Jackson Gulch	9,800	2,500	4,200
	Moon Lake	Midview	5,800	1,700	3,500
		Moon Lake	35,800	600	4,300
	Newlands	Lahontan	290,900	123,200	79,000
		Lake Tahoe	732,000	547,200	360,000
	Newton	Newton	5,300	200	400
	Ogden River	Pineview	44,200	9,600	15,700
	Pine River	Vallecito	126,300	60,700	78,000
	Provo River	Deer Creek	149,700	74,600	86,100
	Scofield	Scofield	65,800	10,000	10,100
	Strawberry Valley	Strawberry Valley	270,000	168,500	147,200
	Truckee Storage	Boca	40,900	12,500	27,600
	Uncompahgre	Taylor Park	106,200	56,700	74,500
	Weber River	Echo	73,900	8,300	13,400
Region 5	W. C. Austin	Altus	166,300	35,100	29,800
	Balmorhea	Lower Parks	6,500	5,300	2,400
	Carlsbad	Alamogordo	131,900	13,500	97,700
		Avalon	6,000	4,600	2,100
		McMillan	38,700	6,400	10,700
	Colorado River	Marshall Ford	1,835,300	589,100	800,500
	Rio Grande	Caballo	340,900	16,600	21,300
		Elephant Butte	2,185,400	32,900	121,500
	San Luis Valley	Platoro	60,000	100	1,200
	Tucumcari	Conchas [1]	465,100	[2] −4,200	177,700
Region 6	Missouri River Basin	Angostura	92,000	35,100	85,700
		Boysen	710,000	521,100	248,800
		Canyon Ferry	1,615,000	971,500	1,517,100
		Dickinson	13,500	3,500	4,000
		Fort Randall [1]	3,900,000	713,100	1,343,100
		Heart Butte	218,700	59,900	65,500
		Keyhole	270,000	7,000	24,300
		Shadehill	300,000	79,500	77,400
	Belle Fourche	Belle Fourche	185,200	60,100	45,100
	Fort Peck	Fort Peck [1]	14,877,000	7,559,300	3,042,900
	Milk River	Fresno	127,200	95,600	105,300
		Nelson	68,800	50,600	41,400
		Sherburne Lakes	66,100	44,600	34,800
	Rapid Valley	Deerfield	15,100	9,800	9,500
	Riverton	Bull Lake	155,000	115,500	110,000
		Pilot Butte	31,600	10,600	10,000
	Shoshone	Buffalo Bill	380,300	293,300	213,700
	Sun River	Gibson	105,000	56,800	60,400
		Pishkun	30,100	26,100	22,500
		Willow Creek	32,400	23,300	25,700
Region 7	Colorado-Big Thompson	Carter Lake	109,100	10,900	21,200
		Granby	465,600	243,600	158,200
		Green Mountain	146,900	64,600	140,700
		Horsetooth	141,800	6,700	28,800
		Shadow Mountain	1,800	1,000	1,400
	Missouri River Basin	Bonny	39,900	37,000	34,900
		Cedar Bluff	176,800	51,600	81,900
		Enders	36,000	27,900	27,600
		Harry Strunk Lake	33,900	18,400	11,800
		Swanson Lake	116,100	23,500	43,300
	Kendrick	Alcova	30,300	14,200	22,600
		Seminoe	993,200	300,500	408,300
	Mirage Flats	Box Butte	30,400	8,700	6,400
	North Platte	Guernsey	44,200	21,700	18,000
		Lake Alice	11,400	2,400	800
		Lake Minatare	57,800	6,400	7,900
		Pathfinder	1,010,900	344,600	215,600

[1] Corps of Engineers Reservoir.
[2] Minus active storage figure due to pumping from dead storage during the month.

CALAMITY POINT

Continued from page 82

is project manager; W. J. Kennish, project superintendent; and L. B. Kuhnle, project engineer. Key personnel for the Bureau of Reclamation are Louis B. Ackerman, construction engineer; G. A. Swanson, office engineer; and H. P. O'Donnell, field engineer.

Palisades Dam is a rolled earth fill structure 270 feet high, 2,100 feet long at the crest elevation of 5,630, and 2,100 feet wide at the base. The 40-foot wide crest will provide a roadway connecting United States Highway No. 26 with the relocated Forest Road on the left side of the reservoir.

The dam embankment is composed of four different zones or types of materials which vary from a relatively fine clay-silt at the center to large rock fragments and cobbles at the upstream and downstream faces. The impervious core of Zone 1 material at the center can actually be considered to be the dam proper, while the other zones of coarser materials serve to keep the core from washing or eroding away and give the structure stability.

The excavation for the dam foundation, tunnels, intake and outlet structures, powerhouse and from borrow areas for the dam embankment will entail moving 17 million cubic yards; 10.1 million yards have been excavated to date. The embankment of 13.8 million yards is completed to Elevation 5500, 130 feet below final crest elevation.

Three tunnels through hard andesite rock of the left abutment, compose the penstock, outlet works, and spillway, respectively. The two lower tunnels, one power and one outlet, have a combined length of 2,800 feet and are finished to a diameter of 26 feet. A penstock manifold from the power tunnel will convey water to the turbines. Two bypass pipes off the manifold will divert water from the power tunnel through gates in the outlet works in emergencies or when the power plant is not in operation. Flow into the outlet tunnel adjacent to the power tunnel will be controlled by six gates in the outlet works control house then pass through the stilling basin where the velocity and surge of water will be dampened by the dentates and dividing walls to prevent stream erosion and damage to the structure. The power and outlet tunnels now serve the important temporary function of diverting the river around the dam proper during construction.

The spillway will utilize the third and largest tunnel, located at a slightly higher elevation and further into the abutment. This tunnel is some 1,860 feet long and 28 feet in finished diameter. The flow of water will be controlled by two 20- by 50-foot radial gates and at the outlet and will flow into the existing river channel through an open concrete lined channel 400 feet long. Normally it will only be used to pass floodwaters in excess of those which can be accommodated by the power and outlet tunnels.

The spillway and outlet works are designed to discharge a maximum probable flood of 90,000 cubic feet a second and a 30-day volume of 2.2 million acre-feet.

PALISADES DAM looking upstream—powerhouse off to right.

SHEEPSFOOT ROLLERS compacting Zone 1 material in the dam.

The powerhouse is located at the downstream toe of the dam adjacent to the stilling basin. It is unusual in that the building above the ground line, is the first powerhouse superstructure to be constructed of brick by the Bureau of Reclamation. The powerhouse has an overall width of 129 feet, 246-foot length, and 113-foot height, and will contain four 28,500-kilowatt generators.

The first generator is scheduled to go on the line in December of 1956, and other three in March, June, and August 1957.

The switchyard will be located on the small peninsula at the middle of the downstream toe of the dam. Two 115-kilovolt transmission lines will originate at the Palisades switchyard and terminate at the Utah Power & Light Co.'s substation at Goshen, Idaho, 55 miles west of Palisades. Provision has also been made for connecting to the 69- and 12.5-kilovolt systems of the Lower Valley REA Cooperative which serve the Swan Valley, Idaho, and Star Valley and Jackson, Wyo., areas.

The three tunnels are completed as are the stilling basin and the outlet channel for the spillway. Work is rapidly progressing on the concrete for the intake and outlet structures. With the passing of high water period, the river is flowing through the outlet tunnel only and workmen are preparing to connect up the penstock manifold to the power tunnel and construct a portion of the outlet works control house.

The powerhouse is moving along toward completion. All of the structural steel has been erected. One-third of the roof and half of the brickwork have been completed. The penstock manifold and butterfly valves have been installed and the hydraulic turbine for Unit 4 is almost ready for hydrostatic tests.

The tunnels, control structures, and powerhouse will require 6,750 tons of reinforcing steel and the placement of 175,000 cubic yards of concrete containing some 200,000 barrels of cement and 9,000 tons of pozzolan. Work accomplished to date on these structures includes the installation of 5,000 tons of reinforcing steel and the placement of 116,000 cubic yards of concrete.

The reservoir behind the dam will be 20 miles long and 3 miles across at its widest point and will extend about 5 miles into Wyoming, and with a normal water surface elevation of 5,621 will have a total capacity of 1,400,000 acre-feet. Storage of water in the reservoir will be started in the spring of 1956. The inundation of the lands in the reservoir area necessitated the relocation of 20 miles of primary State highways, 25 miles of forest road, and the clearing of about 3,500 acres of timberland.

The prime contractor is well ahead of schedule on the dam and powerplant, having completed 71 percent of the work in 59 percent of the time allowed. All work under this contract is required to be completed by September 1957. In addition to the outlay of 3.5 million dollars for new equipment before work could even be started, the contractor has since paid out 7.4 million dollars in wages alone to workmen of every classification. During the construction season of May through October as many as 1,000 men are employed on the job. Materials and equipment for the project

JACKSON LAKE in Grand Teton National Forest, Wyo., has an exposed beach which results from the lowering of the lake for irrigation. It is often unsightly and extremely inconvenient to boating enthusiasts. However, the problem will be remedied in the future as irrigation water is discharged from Palisades Reservoir keeping Jackson Lake at a more uniform level.

are coming from almost half of the 48 States. Cement is being obtained from Idaho, penstock and outlet manifolds from Oregon, reinforcing and structural steel from California, turbines from Pennsylvania, outlet gates from Alabama—manufacturing plants and suppliers throughout the United States are, you might say, actually working on the Palisades project. Even the great Boeing Airplane Co. in Seattle is making equipment for the project. The aggregate value of materials and equipment contracts awarded to date totals 8.6 million dollars.

These are the things we actually see taking place in the shadow of Calamity Point. But there are many other benefits of inestimable value to be derived from a project such as this which are not so readily apparent. Because of the additional water supply which will be made available by the Palisades project, it will be possible to grow more and better crops on the rich and fertile soils of the Upper Snake River Valley. New industries will come into the area to process these agricultural products and reasonably priced electric power will be available to operate the plants.

The project will provide outdoor recreational facilities near the larger population centers of southeastern Idaho. From the number of comments and inquiries already received concerning summer homesites, recreational facilities, boating and fishing possibilities, it is expected that considerable use will be made of the new lake by the 65,000 residents of the immediate area as well as by the tourists on their way to and from Yellowstone and Grand Teton National Parks.

The operation and maintenance of the reservoir and the structures at the damsite will be under the jurisdiction of the Bureau of Reclamation's Regional Director, H. T. Nelson, in Boise, Idaho.

The United States Forest Service, with offices at St. Anthony, Idaho, is responsible for the administration of the occupancy and utilization of all lands adjacent to the reservoir. # # #

N. R. A. CONVENES AT LINCOLN, NEBR.

As this issue went to press the 24th Annual Convention of the National Reclamation Association was scheduled to be held at the Cornhusker Hotel, Lincoln, Nebr., on Monday, October 24, continuing through October 25 and 26.

Secretary-Manager William E. Welsh arranged the preliminary plans for the convention after conferring with President C. Petrus Peterson and other officials of the association from the various Western States. Indications were that the meeting would be very well attended and the speakers would include nationally known authorities in the field of conservation.

Secretary of the Interior Douglas McKay was scheduled to be the principal speaker at the opening session on October 24. His address was to be followed by the transaction of association business including reports from the president of the N. R. A. and other officials.

In addition to Secretary McKay and President Peterson, others scheduled to address the convention included Senators Arthur V. Watkins of Utah and Frank A. Barrett of Wyoming; Gov. Victor E. Anderson of Nebraska; Congressmen A. L. Miller of Nebraska, Clair Engle of California, and Wayne N. Aspinall of Colorado; Lt. Gen. Samuel D. Sturgis, Chief of Army Engineers; Donald A. Williams, Administrator of the Soil Conservation Service; Commissioner of Reclamation W. A. Dexheimer; and Dean W. V. Lambert, College of Agriculture, University of Nebraska.

Senator Barrett's subject for discussion was entitled "The Stakes Are High—The Fight Over Western Water Rights Is Under Way." Congressman Aspinall's topic for discussion was entitled "What Is the Real Value of Reclamation?" while Mr. Williams picked "The Nation's Youth of Our Agricultural Land" for discussion. The specific subjects to be discussed by the other speakers were not known when we went to press but it was generally agreed that all would deal with the various phases of conserving our natural resources.

Secretary McKay, Senator Watkins, and Commissioner Dexheimer, along with President Peterson and other association officials, where scheduled to discuss long-range Reclamation policy based on the recent meeting between President Eisenhower, Secretary McKay, Senator Watkins, and Commissioner Dexheimer.

Other Interior Department and Bureau of Reclamation officials selected to attend the 24th Annual Convention of the N. R. A. were Deputy Solicitor Edmund T. Fritz; Acting Associate Solicitor, Water and Power, Edward W. Fisher; Assistant Commissioner of Reclamation E. G. Nielsen; Assistant to the Commissioner-Information, Ottis Peterson; Chief, Division of Irrigation, Floyd E. Dominy; and Chief, Division of Project Development, N. B. Bennett. #

HARRIET PENNER and CUSTOMER.

DISABLED

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He was inducted into the Army in June 1943. He attended the Officer Candidate School of the Quartermaster School, Camp Lee, Va., and was commissioned a second lieutenant. During his more than 2 years overseas service in the Philippines, Hughes was promoted to the rank of first lieutenant. After having been assigned a post in New York City, but before leaving the Phillppines, Hughes contracted acute anterior poliomyelitis in late 1947.

Fortunately he escaped paralysis in the upper extremities, although the residual effects of the disease left his lower extremities approximately 75 percent paralyzed. He was retired from the Army for physical disability as a captain in November 1948, after almost 5½ years' service.

After establishing his home in Santa Barbara in 1949 Hughes found it necessary to seek employment to support a family. He went to work at the Bureau's newly opened Goleta office of the then Cachuma Unit, Santa Barbara project.

Hughes has served in the Bureau's Goleta office as general clerk and voucher examining supervisor. He is able to be ambulatory through the use of braces on both legs and the use of tubular aluminum crutches.

CHARLES CURRY, who was born without a right hand, lives in a trailer near the construction office of United Concrete Pipe Corp. for which he works. This corporation has completed four prime contracts for Reclamation distribution systems.

Curry has been doing construction work since 1925, as a semitrailer driver hauling heavy equipment, and driver of dump trucks and other trucks. At present he is a construction foreman in charge of earthwork on reservoirs and structures.

Having never had a right hand, Curry intimates he has never missed it greatly. He has been able to do all kinds of work, adapting one hand to do efficiently the same jobs men with two hands could do. He plans to stay in construction work as long as he is able.

When HARRIET PENNER was about 22 years old, she became aware of a haziness of vision. She consulted several doctors but was unsuccessful in having the condition diagnosed. Finally, she went to the Mayo Clinic where the condition was diagnosed as retinitis pigmentosa. In lay terms, this means that the eye is aging much more rapidly than the rest of the body. In this particular case, Harriet's eyes are probably the equivalent of 80 years old. The condition of the eyes will continue to deteriorate resulting eventually in total blindness.

This diagnosis created a minor crisis in Harriet's life. Up to this time she had been very active performing the functions of a good housewife and working as a medical stenographer. Harriet heard a radio program on vocational rehabilitation. She inquired of the proper State authorities and was found acceptable and qualified for such training. It was proposed to her that she train as a vending stand operator. While she had no experience or background in this type of activity, she expressed a willingness to undertake such training. As a result, and under the authority of the Federal Randolph-Shepard Act which permits blind people to operate concessions in Federal buildings, Harriet is cheerfully and happily operating her own business for the convenience of the employees of the Bureau of Reclamation and Geological Survey in Region 2 headquarters.

RICHARD L. BRIGHT, senior clerk in warehouse accounting, Salt River Power District, Phoenix, Ariz., started work for the Salt River Power District in 1951 soon after the State Division of Vocational Rehabilitation got him an artificial leg. He had no right leg and had a hard time obtaining employment until he was put on the staff as a grade C junior clerk which is the lowest grade.

In 3 years, this one-legged employee rose to senior clerk, grade A, which is seven steps up the ladder in this short time.

He was an Elyria, Ohio, electrician and was struck by an automobile and got a painful bone injury. He endured the pain for 4 years and then moved to Arizona. By 1951 he demanded that his right leg be removed because of the intense pain.

After the operation the State Rehabilitation Division arranged for him to take a business machine and office course at Phoenix Tech.

Richard L. Bright is certainly one of the bright stars among the employees of the Salt River Power District warehouse accounting. His cheerful attitude and ability to get around easily makes him very popular with everybody.

We should like to take this opportunity to point out that recently the Luke Greenway Post of the American Legion in Phoenix presented its certificate of recognition to the Salt River project officials for hiring 254 handicapped persons.

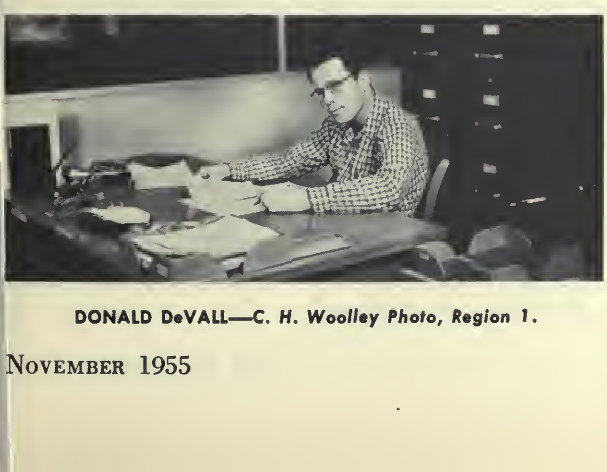
DONALD D. DEVALL, known to his coworkers as "Dunc" has been employed by the Bureau of Reclamation on the Hungry Horse project in Montana since 1950. He is afflicted with arthritis of the spine.

RICHARD L. BRIGHT—*Salt River District Photo.*

Dunc is a cheerful and efficient worker. He served as a clerk-typist in the Materials Engineering Branch during the construction of the project, and was later promoted to a position as office assistant to the Chief of the Operations Division. His only concession to his physical handicap seems to be that he organizes his work to make every motion count! This results in a volume of work that a nonhandicapped worker could envy.

Dunc is an Army veteran of World War II. We believe that through his ability and determination he will continue to show progress in his work.

PRESIDENT EISENHOWER IN HIS PROCLAMATION DECLARING THE FIRST WEEK IN OCTOBER AS THE 11TH NATIONAL EMPLOY THE PHYSICALLY HANDICAPPED WEEK CALLED UPON THE PEOPLE OF OUR NATION TO COOPERATE WITH THE PRESIDENT'S COMMITTEE IN CARRYING OUT THE WILL OF CONGRESS WHICH AUTHORIZED THE "WEEK" BY A JOINT RESOLUTION APPROVED AUGUST 11, 1945. HE ALSO URGED GOVERNORS OF STATES, OTHER PUBLIC OFFICIALS, LEADERS OF INDUSTRY AND LABOR, MEMBERS OF CIVIC, RELIGIOUS, AGRICULTURAL AND FRATERNAL ORGANIZATIONS TO PARTICIPATE ACTIVELY IN THIS OBSERVANCE.



DONALD DeVALL—*C. H. Woolley Photo, Region 1.*

SCOUTING CONSERVATION

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fishing area as are most of the reclamation reservoirs scattered through the Western States.

From Palisades, the touring conservationists continued up the Snake River into the fastness of Jackson Hole in the shadow of the towering Tetons. Here many of the boys who are from the plains or lowland coastal areas saw for the first time the grandeur of the high Rockies. They learned too, through explanations by representatives of the National Park Service, Forest Service, and Bureau of Land Management, how these areas of public owned land are being protected as watersheds and also reserved for recreation and beneficial use by the vacationing millions.

In the fastness of the primitive area of the southeastern arm of Yellowstone Lake they caught fish to their hearts content, on a 2-day camping trip. But they tossed them back as fast as they caught them for the limit within Yellowstone National Park is three fish per day.

Camping out in the sharp, frosty air of the Continental Divide on Togwotee Pass, they lived the life of a forest fire fighter for a night, receiving an airdrop of supplies and burrowing into paper sleeping bags to keep warm at the lights-out signal.

But they were awake in time to take off early the next morning on the last leg of the trip down beautiful Wind River Canyon where they found water being put to use again irrigating farmlands on the Riverton reclamation project. Here too they were guests of the first Americans this time on the Wind River Reservation. Here is the grave of Sacajawea, the Indian maiden who guided the Lewis and Clark expedition and the Explorers paid homage to her memory as one of the greatest of trailblazers.

Thus in 2 weeks of touring Colorado, Utah, Idaho, and Wyoming, during which they crossed the Continental Divide nine times, the youths examined the public lands watershed area which mothers the headwaters of our great rivers, provides sanctuary for wildlife and a back-to-nature retreat for vacationing America.

They returned to their homes armed with facts, figures, pictures and will even be supplied with motion-picture strips supplied through National Boy Scout headquarters to help tell the story of conservation.

# # #

Agriculture Department Official Cites Need for Irrigation

At the 43d annual meeting of the Chamber of Commerce last spring in Washington, D. C., agriculture's need for water was strongly emphasized in a paper by Hon. Ervin L. Peterson, Assistant Secretary of the United States Department of Agriculture.

Excerpts from the paper, entitled "Water For Our Farms," are as follows:

"* * * The purpose of these remarks is to point up the fact that water for agriculture is inseparable from water for other uses * * *.

"* * * Agriculture's representatives need to understand, evaluate, and relate agriculture's interests to the total interest in water, its development, management and use. In fact, agricultural policy does and will continue to affect water policy as well as the physical development, management, and use of water, for water and land cannot be separated.

"* * * Now what is agriculture's need for water, or perhaps a better wording is: What is the Nation's need for agriculture?

"First, we now have 165 million people to feed and clothe. It is estimated that our population will be about 178 million in 1960. In addition, we expect to retain and add to our foreign markets for agricultural commodities.

"Now, what is our production base? Over three decades ago we reached a cropland base of approximately 350 million acres. That base has never been significantly exceeded, nor is it likely to be in the near future. As new land has been brought to production, other land has gone out of production by abandonment, for industrial and urban expansion, development of suburban areas, highways, airports, and other assorted uses. For the foreseeable future we must produce our foods, fibers, and agricultural products for industrial use from cropland now in use.

"* * * The geographic frontier is long gone—the vertical frontier of science and technology is beginning to unfold. As it unfolds, as we seek more production from the same acres, agricultural water becomes increasingly important.

"Competent authorities maintain that any program to increase per acre yields of crops in the humid area of our country—that part generally east of the Mississippi River—must include irrigation. To produce a bushel of corn requires about 10,000 gallons of water—a bushel of oats about 7,000—a ton of cured alfalfa hay about 200,000 gallons.

"As the use of improved seed, as increased amounts of fertilizer are applied, and as better growing practices are applied, the need for water goes up. For example, reports indicate that at Blacksburg, Va., rainfall during the past 56 years has been adequate to produce 25 bushels of corn per acre every year except two. This same rainfall would have been adequate to produce 75 bushels per acre only about half of those years. Yet as a result of application of known methods of farming to growing corn, 75 bushels per acre is a potential production figure at Blacksburg if water is available. This example repeats itself in some form throughout the country. Thus water supply and not fertilizer or lack of knowledge is an important limiting factor to any significant increase in food production which will ultimately be required by a growing nation.

"* * * In this effort Government has played and will continue to play a significant and important role. Let us see to it that this role is cooperative effort between people and their Government—local, State, and Federal—for the enlargement of resource capabilities and use where there is such real opportunity to develop a stronger, better America.

"* * * We have come to recognize that the end purpose of conservation is the welfare of the people, both present and future. There is rapidly developing a greater teamwork in our approach to problems of our conservation. This is particularly true with respect to water developments. All of us as individuals, as organizations, as Government, have a proper place to play on this team. All interests, private, local, State, and Federal must work together in our efforts to develop a strong, prosperous, stable, and free America.

"* * * Let us move forward to the establishment and perpetuation of an agriculture that is prosperous, dynamic, alert and free—an agriculture that can discharge its responsibilities fully and effectively, while at the same time maintaining for the people on the land rich and rewarding opportunity.

"This Administration is fully committed to helping our people build a sound, long-time farm policy for this Nation." #

WATER SUPPLY

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severely curtailed in the middle Rio Grande Valley. Along the lower Rio Grande below Elephant Butte Reservoir, streamflow has been low but extensive use of irrigation wells has made up for most of the water shortage. Storage in reservoirs on the Rio Grande and its tributaries is much below normal and similar to the fall of 1953 and 1954. Several years of high snowfall and runoff will be necessary to bring storage back to adequate levels. Water supply on the Carlsbad project was fairly good but much of the reservoir water from the flood of last fall has been used.

OKLAHOMA.—Streamflow and rainfall were deficient during the 1955 growing season on the W. C. Austin project. However, water supply was adequate and crop conditions are reported as good.

OREGON.—The irrigation reason of 1955 has been one of extreme water shortage in many areas of Oregon. Deficiencies in water supply were particularly severe in the eastern section of the State.

In Malheur County water deliveries were stopped in mid-August by two districts. The Owyhee project is more fortunate and will continue to deliver some water until October 10, but a record low holdover of about 50,000 acre-feet is probable.

There is no water left in Unity Reservoir in Baker County, but the holdover storage in Wallowa Lake in Wallowa County appears to be better than for 1951, another dry year.

The flow of the Umatilla River has been very low but both McKay and Cold Springs Reservoirs have better water supplies than at this date last year. Crook County has been hard hit except for lands served by the Ochoco project. The reservoir is now the lowest it has been since 1949 and will probably be empty.

Deschutes County has had good water supplies where storage was available. Crescent Lake and Crane Prairie Reservoirs are now at very low levels. In Lake County, Drews Creek Reservoir together with Cottonwood has furnished good water supplies but current storage is very low. Elsewhere in this area the shortage of water has curtailed hay crops. Range conditions are poor.

Klamath Basin lands have been well supplied this year but storage in Gerber and Clear Lake reservoirs is very low. Gerber has less water available than at any time since 1931. Inflow to Upper Klamath Lake has been 70 percent of the 10-year average (1943–52).

In the Rogue River Basin shortages have been somewhat less than originally estimated and most crops had reasonably adequate water. Pasture lands suffered the greatest shortage. All reservoirs are at low levels. Medford and Rogue River Valley irrigation districts are still drawing water in limited amounts. The Talent irrigation district stopped deliveries on August 31.

Williamette Valley lands have experienced some water shortage but not to the extent suffered in eastern Oregon. Water storage in all Oregon reservoirs is currently very low or missing entirely. Present storage in 25 reservoirs is 66 percent of the average (1943–52) compared with last season when it was 95 percent of average. Much above average runoff will be needed next spring to produce the water needed for satisfactory water supplies. Watershed soils are much drier than for many years and will require considerable "priming" with rains or snowmelt water before runoff can begin.

SOUTH DAKOTA.—In general, storage in western South Dakota is considerable above the short-term normal for its reservoirs. The exception is the Belle Fourche Reservoir which is at 50 percent of the 1943–52 average. Light precipitation during the summer months has left a soil moisture deficit which will make above normal rainfall during the fall and winter desirable.

TEXAS.—Streamflow in the Rio Grande in western Texas was extremely short. Crop production in this area was not materially affected due to groundwater development over the past few years. There has now been at least 5 years of deficient streamflow in this section of the Rio Grande.

Water supply along the Pecos River was reasonably adequate due to storage in Red Bluff Reservoir after the Pecos River flood of last October. However, most of the storage has been used. Storage in Red Bluff Reservoir is now 25,000 acre-feet as compared to an average carryover of about 45,000 acre-feet.

UTAH.—The 1955 irrigation season in Utah has developed much as anticipated when the forecasts were issued last spring. Mild to severe water shortages have been felt throughout the State, with the most serious conditions existing in the southern counties and in the central Utah counties of the Colorado River drainage. The northern half of the State has generally experienced only mild shortages, with exceptions being in Rich County of the upper Bear River, the eastern part of the Uintah Basin and some areas around Utah Lake.

With minor exceptions, water users with reservoir storage rights have generally had sufficient water to mature their crops. This, however, has required that reservoir storage be depleted by three times an average amount.

With reservoir carryover storage being 37 percent of capacity compared to an average of 55 percent, above average runoff is needed in 1956. This is particularly desirable for some of the southern counties where three consecutive years of drouth have been experienced.

WASHINGTON.—Washington reservoir status as of September 1, 1955, is 7 percent above the 1943–52 average. During the spring all reservoirs were exceptionally low due to a late runoff and early season irrigation demands. April and May streamflow was low but June and July streamflow was well above average. August streamflow has receded to a near normal level. Precipitation during the spring was normal or slightly below but in July picked up to well above normal, then fell to a near record low in August. Snowfall in the mountains of Washington during the winter produced the normal volume runoffs expected. Temperatures during the spring and summer months have been generally below normal in the State of Washington.

During the months of April, May and June the increase in storage in Franklin D. Roosevelt Lake was approximately 4,475,000 acre-feet of water as compared to 1,439,000 last year for the same period.

The irrigation reservoirs in the Yakima watershed expect a good carryover if normal precipitation occurs this fall.

Mountain soil moisture is low due to the lack of precipitation during August.

WYOMING.—Reservoir storage for the state of Wyoming is down to 68 percent of normal as of September 1, 1955. North Platte storage is 56 percent of normal and Jackson Lake on the Snake River has 67 percent. Storage on the Bighorn River excluding Boysen Dam is about 50 percent of normal. The Keyhole Reservoir on the Belle Fourche is considerable above that of recent years. Soil moisture in most irrigated areas is low as a result of light to moderate precipitation during the summer season. With the exception of the Kendrick project on the North Platte, water supply for the State next year will be short if winter snowfall does not indicate well above normal runoff.

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Construction and Materials for Which Bids Will Be Requested Through December 1955[1]

Project	Description of work or material
Boulder City, Nev.	Rehabilitating the Bonlder City trickling filter sewage-disposal plant.
Boulder Canyon, Nev.	Rehabilitating the Hoover Dam sewage-disposal plant.
Central Valley, Calif.	Constructing about 8 miles of earth canal, partly earth-lined, including culverts, 7 farm- and county-road bridges, and 4 radial gates in checks and wasteways. Corning Canal, near Corning.
Do	Constructing 2 turnouts, 2 traveling water screens, about 4,000 feet of 220-c. f. s. capacity concrete-lined canal with bottom width of 4 feet, and about 5 miles of 69- to 90-inch precast concrete pipe. Shafter Wasco Distribution System, near Shafter.
Do	Constructing about 5.5 miles of 12- to 24-inch reinforced precast concrete-pipe laterals including utility crossings, 3 railroad crossings, 1 highway crossing, stationary moss screen structures, 1 venturi meter and 3 line meters. Contra Costa Distribution System, near Antioch.
Colorado-Big Thompson, Colo.	Furnishing all materials and performing all work for rehabilitation of the South Platte Supply Canal Diversion Dam. Work will include constructing a concrete overflow section and a 20-inch steel pipe flume, and replacing three 4- by 4-foot sluice gates and three 4- by 3-foot headgates. On Boulder Creek about 10 miles east of Boulder.
Columbia Basin, Wash.	Constructing about 10 miles of concrete-lined canals and laterals, 1 mile of soil-cement-lined lateral 6 miles of wasteways and drains. Block 89, West Central Part, 10 miles south of ephrata.
Do	Constructing about 12 miles of unlined laterals, drains, and wasteways. Near Connell.
Do	Enlarging about 15 miles of existing lateral modifying existing structures and constructing additional structures. Crab Creek Lateral, north of Corfu.
Do	Constructing about 13 miles of laterals and sublaterals and 1 mile of wasteway. Block 18, Third Part, near Connell.
Do	Constructing about 16 miles of concrete-lined laterals and 6 miles of wasteways and drains. Block 89, East Central Part, 11 miles south of Ephrata.
Do	Constructing about 16 miles of wasteway channels and constructing concrete drops, chutes, and bridges. Six to 12 miles southwest of Mesa.
Do	Constructing a 15-foot 4-inch concrete and steel pipe siphon, 15,700 feet long, including inlet and outlet structure. Wahluke Siphon, about 6 miles south of Othello.
Do	Constructing the Evergreen Pumping Plant, an indoor-type plant with eight electrically driven horizontal pumping units of 253-c. f. s. total capacity. Near Quincy.
Do	Constructing 7 O&M 2-bedroom houses with basements and garages and 1 concrete block 10-truck garage. South of Ephrata.
Do	Eight synchronous-motor-driven, horizontal, centrifugal-type pumping units, for Evergreen Pumping Plant.
Deschutes, Oreg	Constructing Haystack Dam, a 600,000-cubic-yard earthfill dam, 83 feet high and about 1,250 feet long at the crest. On Haystack Creek, about 12 miles south of Madras.
Fort Peck, Mont	Constructing a 16-mile, 69-kilovolt, wood-pole, H-frame transmission line from Fort Peck Switchyard to Whately Substation.
Michaud Flats, Idaho.	Four synchronous-motor-driven, horizontal-centrifugal-type pumping units for American Falls Pumping Plant.
Do	Constructing office, warehouse, and shop buildings. All materials to be furnished by the contractor. Near American Falls.
Middle Rio Grande, N. Mex.	Rehabilitating the San Acacia Diversion Dam on the Rio Grande River, 12 miles north of Socorro.
Do	Clearing and enlarging about 11 miles of Bernalillo Riverside Drain from a 15- to a 30-foot bottom width and removing existing structures and constructing new structures. Atrisco Feeder Canal, near Albuquerque.
Do	Constructing a 78-inch monolithic concrete or precast concrete pipe siphon, a concrete wasteway drop, and levee crossing with fixed-wheel gate. Near Albuquerque.
Do	Blading, cutting, filling, placing gravel road surface; extending existing flumes, culverts, and inlets; moving existing drain inlets; installing pipe anchors on existing culverts; constructing ramps, flumes, culverts, inlets and timber bridge; and removing various existing culverts, inlets, weirs and timber bridges. Extending about 85 miles south from Albuquerque.
Minidoka, Idaho	Constructing the Heyburn Substation will include grading and fencing the site, constructing concrete foundations and a small service building, furnishing and erecting steel structures, and installing a 138/34.5/4.0-kilovolt transformer and related electrical equipment. Near Heyburn.
Missouri River Basin, Kans.	One 8- by 10-foot fixed-wheel gate including frames and control equipment for outlet works at Lovewell Dam.
Missouri River Basin, Minn.	Constructing the Granite Falls Substation will include grading and fencing the site, constructing cocrete foundations and a 40- by 90-foot service building, furnishing and erecting steel structures, and installing electrical equipment.
Missouri River Basin, Mont.	Constructing Yellowtail Dam, a 1,660,000-cubic-yard concrete arch structure, 520 feet high and about 1,450 feet long at the crest, and constructing a powerplant to have an ultimate installed capacity of 200,000 kilowatts, and service roads and parking areas. On the Big Horn River, within the Crow Indian Reservation, about 45 miles southwest of Hardin.
Do	Constructing a 7-foot-diameter horseshoe tunnel about 2.6 miles long. Helena Valley Tunnel, 15 miles east of Helena, adjacent to Canyon Ferry Dam.
Do	Two vertical-shaft, hydraulic-turbine-driven pumping units. Helena Valley Pumping Units.
Do	Constructing 1,100 feet of 72-inch steel outlet pipe, concrete control house, and concrete stilling basin. At Tiber Dam, 13 miles south of Tiber.
Do	Constructing about 34 residences, an administration building, and several service buildings at Yellowtail Dam site. Near Hardin.
Do	Constructing streets, sidewalks, and water supply and distribution, sewage, and electrical distribution systems for a 400- to 500-person community at Yellowtail Dam site, near Hardin.
Missouri River Basin, Nebr.	Constructing 12.2 miles of earth laterals and appurtenant structures. Franklin, Franklin South Side and Naponee Canals. Between Republican City and Superior.
Missouri River Basin, Wyo.	Constructing Anchor Dam, a 66,000-cubic-yard concrete arch structure 200 feet high and 550 feet long. On Owl Creek, a tributary of the Big Horn River, about 40 miles northwest of Thermopolis.
Do	Constructing 2.9 miles of earth canal and 700 feet of nonreinforced concrete-lined canal, rehabilitating 0.7 mile of earth canal, and constructing Lucerne Pumping Plants Nos. 1 and 2. Near Thermopolis.
Do	Two motor-driven, vertical, turbine-type pumping units; four motor-driven, horizontal, centrifugal-type pumping units; and one motor-driven, gear-type oil pumping unit for Glendo Power plant.
Do	Furnish and install two 13,333-kva, 180-rpm, 0.9-power factor, 6,900-volt, vertical-shaft generators. Glendo Powerplant.
Palo Verde Diversion, Arizona-Calif.	Constructing an earthfill dam 1,230 feet long and 50 feet high, a gated concrete spillway structure, a concrete canal headworks structure, 30 miles of levees and drains, and removing an existing rock weir and cableway. Palo Verde Diversion Dam and Levee System, on Colorado River upstream from Blythe, about 9 miles by Highway No. 95.
Provo River, Utah	Installing two 2,750-kilovolt-ampere, vertical-shaft generators driven by 3,500-horsepower Francis turbine; constructing a structural steel superstructure with concrete masonry units on the existing substructure; installing a 15-ton bridge crane and switchgear; and constructing a 30- by 60-foot switchyard including takeoff structure and transformer foundation. Deer Creek Power Plant and Switchyard, near Provo.
Colorado River Front, Calif.	All steel tugboat, welded construction; overall length, 60 feet; breadth, molded, 20 feet; depth, molded, 6 feet 9 inches; about 800 horsepower; maximum draft fully loaded, at rest, not to exceed 4.5 feet. To be launched on Colorado River at Needles.
Solano, Calif	Constructing about 6.2 miles of concrete-lined canal and structures. Putah South Canal, near Winters.
Weber Basin, Utah	Earthwork and structures for 6.5 miles of precast concrete pipeline including turnouts, manholes, air valves and blowoffs. Between Salt Lake City and Ogden.
Yakima, Wash	Constructing a powerplant on Wasteway No. 2 of the Roza Main Canal. Also to be constructed are headworks diverting water from the existing wasteway into steel penstocks and discharging from the plant between training walls back into the wasteway. Near Yakima.
Do	One vertical-shaft, Francis-type turbine with a capacity of 18,000 horsepower at an effective head of 158 feet and one 11,250-kilowatt, 6,900-volt, 0.95-percent power factor, 225 revolutions per minute generator for Roza Powerplant.

[1] Subject to change.

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Major Recent Contract Awards

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DC-4346	Parker-Davis, Ariz.-Calif.-Nev.	Aug. 16	Construction of additions to Wellton-Mohawk switchyard	Powerline Construction Co., Nashville, Tenn.	$91,057
DS-4358	Missouri River Basin, N. Dak.	July 18	Three control boards and one addition to control board for Jamestown and Fargo substations, schedule 1.	General Electric Co., Denver, Colo.	57,428
DS-4408	Palisades, Idaho	July 7	Seven 115-kilovolt power circuit breakers for Palisades switchyard.	Allis - Chalmers Mfg. Co., Denver, Colo.	147,730
DC-4411	Gila, Ariz	July 13	Construction of earthwork, concrete lining, and structures for Texas Hill Canal and distribution system.	Vega Engineering and Grading Co., Berkeley, Calif.	1,554,847
DC-4416	Weber Basin, Utah	July 22	Construction of Stoddard Diversion Dam and Gateway Canal, stations 1+52.2 to 48+19.7.	A. S. Horner Construction Co., Denver, Colo.	495,917
DC-4426	Colorado-Big Thompson, Colo.	July 18	Construction of earthwork and structures for Firestone Siphon, South Platte Supply Canal, stations 1062+40 to 1094+55.	F. H. Linneman, Inc., Denver, Colo.	138,617
DC-4428	Missouri River Basin, Wyo.	Aug. 30	Construction of switchyards for Hanover pumping plants Nos. 1, 2, 3, and 4, and 34.5-kilovolt tapline for Hanover pumping plant No. 2; and switchyards for Bluff pumping plants Nos. 1 and 2.	Spence Electric, Moscow, Idaho.	52,694
DS-4429	Palisades, Idaho	Aug. 26	1 main control board, 1 annunciator relay cabinet, and one set of relays for Palisades powerplant, schedule 1.	Gustaveson, Inc., Kansas City, Mo.	64,895
DC-4431	Palisades, Idaho	Aug. 3	Construction of 60 miles of Palisades-Goshen 115-kilovolt transmission lines.	Richards and Associates, Inc., Carrollton, Ga.	606,302
DC-4437	Missouri River Basin S. Dak.	Sept. 14	Construction of Pierre warehouse	Bryce Black, Dell Rapids, S. Dak.	77,240
DC-4442	Middle Rio Grande, N. Mex.	Aug. 9	Construction of earthwork, clearing, and structures for rehabilitation of 21.6 miles of drains, Unit CE-1.	D. D. Skousen and Son, Albuquerque, N. Mex.	111,936
DC-4449	Palisades, Idaho	Aug. 3	Construction of earthwork, structures, and surfacing for relocation of Forest Service Road between McCoy Creek and Salt River, Palisades reservoir.	Dale Aslett Sand and Gravel, Twin Falls, Idaho.	104,989
DS-4450	Missouri River Basin, Wyo.	Sept. 19	Two 16,750-hp hydraulic turbines for Glendo Powerplant	S. Morgan Smith Co., York, Pa.	434,850
DC-4455	Palisades, Idaho	Aug. 1	Construction of earthwork, structures, and surfacing for completion of relocated Idaho and Wyoming State Highways, U. S. Nos. 26 and 89; and construction of Indian Creek detour road, Palisades reservoir.	Holmes Construction Co., Heyburn, Idaho.	442,393
DC-4456	Colorado-Big Thompson, Colo.	Sept. 8	Rehabilitation and enlargement of Coal Ridge section of South Platte supply canal, stations 315+00 to 1026+84.	G. L. Tarlton Contracting Co., St. Louis, Mo.	448,435
DC-4460	Solano, Calif	Sept. 7	Construction of earthwork, structures, and surfacing for relocation of California State Highway Route 102, from 15 miles east of Rutherford to Route 6, Monticello reservoir.	R. A. Farish Co., Stockton, Calif.	600,819
DC-4462	Columbia Basin, Wash	Sept. 7	Construction of earthwork, concrete lateral lining, and structures for North part of Block 89 laterals, wasteways, and drains, West Canal Laterals.	Henry C. Werner, George W. Lewis, Tauf Charneski, Eugene, Oreg.	281,941
DC-4463	Cachuma, Calif	Sept. 7	Construction of earthwork, steel pipe lines, and pumping plant for Lateral 10-L Extension, Carpinteria distribution System.	J. E Young Pipe Line Contractor, Inc., Los Angeles, Calif.	43,556
DC-4467	Middle Rio Grande, N. Mex.	Sept. 14	Construction of earthwork, clearing, and structures for rehabilitation of 12.2 miles of drains, Unit AW-2.	Miller, Smith and O'Hara, Inc., Albuquerque, N. Mex.	99,292
DC-4472	Central Valley, Calif	Aug. 30	Furnishing and installing armature winding for one generator unit at Shasta powerplant.	General Electric Co., Denver, Colo.	152,250
DC-4474	Missouri River Basin, N. Dak.	Sept. 23	Construction of Ellendale substation and installation of supervisory control and telemetering equipment for Jamestown substation.	Northolt Electric Co., East Grand Forks, Minn.	47,731
DC-4477	Middle Rio Grande, N. Mex.	Sept. 9	Construction of earthwork, clearing, and structures for rehabilitation of 23.5 miles of drains, Unit AE-3.	Allison and Haney, Albuquerque, N. Mex.	188,873
100C-223	Medford Irrigation District, Oreg.	Aug. 3	Rehabilitation of Four Mile Lake Dam and Fish Lake Dam	R. K. Shelton Construction, Roseburg, Oreg.	69,550
100S-226	Minidoka, Idaho	Sept. 7	Twenty-one 2,300-volt motor control units for Group 4 deep-well pumping units and for relift pumping plant.	Mine and Smelter Supply Co., Salt Lake City, Utah.	44,688
100C-230	Do	Sept. 1	Construction of earthwork and structures for laterals, sublaterals, and well stilling pools from Group 4 wells.	Olof Nelson Construction Co., Logan, Utah.	148,905
200C-278	Central Valley, Calif	Aug. 19	Moving and renovating residences; renovating existing buildings; constructing garages; and installing utilities for O&M headquarters at Friant, Calif.	Robert Jolly Construction Co., Fresno, Calif.	173,748
400C-55	Weber Basin, Utah	July 18	Construction of Bountiful drains A-1, A-1-1, and A-1-2	Earl Vincent Chettle, Salt Lake City, Utah.	120,413
703C-373	Missouri River Basin, Wyo.	July 27	Construction of field office, testing laboratory and utilities for Glendo Dam.	Wyoming Steel Buildings, Casper, Wyo.	31,498
700C-381	Colorado-Big Thompson, Colo.	Sept. 7	Construction of forebay channel protection for Willow Creek pump canal.	Curwell-Anderson Co., Loveland, Colo.	48,235
703C-385	Missouri River Basin, Nebr.	Sept. 21	Installing evaporative cooling system and appurtenances for 30,000-kilovolt-ampere synchronous condenser at Gering substation.	Eagle Construction Corp., Loveland, Colo.	45,413

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February 1956

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In this issue . . .

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Bureau of Reclamation, Washington, D. C.

J. J. McCARTHY, Editor

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* * *

30 Years Ago in the Era

The Progressive Project Farmer
What He Is—
- Patient when patience is desirable
- Peaceful and pleasant in all classes of company
- Peer in his special field of farm work
- Persistent and persevering
- Powerful in perception but not repugnant
- Pleasing in personality
- Philanthropic and benevolent
- Pioneering toward educational advancement
- Plain, clear, and simple in his habits of daily life
- Playful, but plucky and progressive
- Popular, but positive and dependable
- Prompt in the payment of personal dues
- Picking each day the proper path toward permanent progress
- Proclaiming silently his purpose to push to the front
- Prosperous, but also positive in promoting public welfare

What He Is Not—
- Passive concerning perplexing questions
- Pessimistic concerning a doubtful future
- Pest-like with his associates
- Petrified in his thoughts and habits
- Pilferous or petty with the precious rights of others
- Plundering the property of his neighbors
- Petting himself in his own mistakes
- Pompous about his accomplishments
- Procrastinating the attack of hard work
- Pouting of pow-wowing about his misfortunes
- Prematurely demanding high prices for inferior products
- Pretending to be what he is not
- Preying on the rights of the weak or the humble
- Prodigal or wasteful of his money, his time, or his personal energies
- Profane or irreverent to his God

—Prof. O. W. Israelsen
Utah Agricultural College

weed control by grass competition

it works on the Columbia River Basin

by DELBERT D. SUGGS, Agriculturist, Bureau of Reclamation, Region 1
Columbia Basin Project, Ephrata, Washington

There is more than one way to skin a cat. Likewise, there is more than one way to control weeds on the ditchbanks of new irrigation projects. One way in which the Columbia Basin Project is really sold, because it is proving more permanent and lower in cost, is the use of competitive grasses.

This same idea is being put to use also by State and county engineers on road and highway rights-of-way with good success and when weed districts are formed in the project area that united front, so important in the battle against noxious weeds will have been achieved. And don't think that plenty of noxious and other weeds are not just waiting to invade new project farm lands through natural drainage areas and irrigation systems.

Crab Creek is the longest and driest stream in Washington and it drains 1900 square miles of dry farm land and other lands before entering the Columbia Basin Project. Its weed infested flood waters pass through the northern part of the project into the Potholes Reservoir which supplies the southern part of the Project with water. The setup is a natural for importing and spreading noxious weeds.

More than 4,000 acres of white top, Canada thistle, morning glory, and Russian knapweed were sprayed in the Equalizing Reservoir before it was filled. However, all range land draining into the Project reservoirs could not be sprayed. The hazard of infesting the new farm lands was there and it was real. Then too, the movement of people, livestock, and equipment inevitably brings into the Project area large quantities of weed seeds to establish beachheads from which other infestations start.

Some weeds take over in a blitzkrieg operation, as many Columbia Basin Project farmers can tell you. By 1955, barnyard grass, a summer annual weed called water grass by some westerners, had made its presence known to sugar beet and bean farmers after only one or two years.

Other weeds are slower, but more insidious in their attacks and may be just as dangerous to the farmers. They infiltrate and encamp on waste areas. Then with the aid of wind, water, and human transportation, they overrun clean lands on new farms before the real danger is realized.

On the Columbia Basin Project, a strategy was designed years ago by the Bureau of Reclamation to keep the project from being caught with "too little and too late" in the battle we knew was forthcoming. Even as fire is fought with fire, the theory was to use plants to fight plants by establishing tough, yet docile, grasses on the ditchbanks before the weeds arrived. In short, get there first with grass.

This gave rise to the tactical problem—what were the best grasses to employ? Our allies, Soil Conservation Service, Agricultural Extension Service, and Experiment Stations of the State College of Washington, and other agencies, cooperated fully and agreed that tests should be made of the most promising species before final plans were made for the main encounter.

The first trial plants were made on Irrigation Block 1, where irrigation water was available to about 5,400 acres in 1948. Water was scheduled for 66,000 acres in 1952, so time was available to learn much about suitable grasses before the enemy amassed its army of weeds.

The requirements for the competitive grasses were stringent as some had to be drouth resistant species and live on dry, sandy soils, while others had to be adapted to silty soils, wet locations, gravelly ditchbanks or alkaline soils.

Streambank wheat grass came nearest to meeting the over-all or general conditions including tolerance of highly alkaline soils. Crested wheatgrass was found best for continuously dry sites. Brome and red top thrive on the wetter ditchbanks. It was known that the native grasses like Indian rice grass, stipa, slender wheat grass, and the few remaining stands of native Idaho fescue held their own in competition but they had 40 or 50 years to become established. Even though our grass plantings had to be established within 4 or 5 years to be effectively competitive with weeds, none of the grass men gave up hope.

Our early experience showed that the most favorable time for seeding grasses was between the late fall rains and the first winter freeze. While this period was often less than one month, about 75 percent of our grass plantings succeeded. Slowly, but surely, grass has appeared on the flat berms and steep slopes of the ditchbanks.

More experience and the development of special planting methods have extended the critical planting period until we are now able to plant from October 1 to February 1 under favorable conditions. Grain or grass drills can be used in the winter months if the ground is not frozen or covered with snow. The melting of later snows and spring rains usually results in good germination and stand of grass.

We have found that seed broadcast on snow often gives poor results unless the ground is not frozen and the operation is followed by disking or harrowing to mix the seed, snow, and unfrozen soil.

On gravelly ditchbanks, drilling, disking, or harrowing is not practical. However, if broadcast when the ground is bare, the seed lodges amidst the gravel and a good competitive stand of grass usually is produced in about 2 years.

We devised special equipment to facilitate seeding on the side slopes of ditchbanks composed of loose, newly excavated soil. A finger weeder and a 6-volt electric broadcaster were clamped to a drawbar boom hinged to the side of a truck-tractor. This seeder attachment sows a 4, 8, 10, or 14 foot swath and can be adjusted to positions from 45° above to 45° below horizontal.

In addition to grass seeding by Bureau crews this activity was included in construction contracts as a trial. Results to date have been satisfactory, even though the idea was new, both to the contracting firms and to the Bureau inspectors in Region 1. Among other advantages we believe the contract method encourages the contractor to complete canal construction in time to take advantage of the best planting conditions in the fall. When seeding must be delayed until the following fall, cost studies show that the necessary expenses of removing the inevitable Russian thistles before seeding is equal to or greater than the cost of seeding the grasses. With each now contract, improved as well as standardized methods are being utilized, but some problems still need to be solved.

Top right: 3½ year stand of crested wheat grass on gravel near West Canal is thin, but get limited moisture before the weeds. At right: *These are weeds! Eight different kinds*—one poisonous, two noxious, five undesirable. Grass on this road borrow ditch carrying drain water could keep the weeds from getting a stand.

On the Columbia Basin Project field costs for seeding vary from $6 per acre under the most favorable conditions to about $50 per acre in a few critical locations requiring some hand work. Average per acre field costs, 1955 were:

Seed, 10 lbs. per acre at 50¢ per lb	$5.00
Labor at $1.75 per hour	2.25
Equipment and transportation	7.75
Total average field cost per acre	$15.00

The grasses which have been particularly effective and the types of areas to which each is adapted are given below:

Grasses Adapted on Columbia Basin Project Waterways

Crested Wheat Grass (Standard and fairway strains)	Dry to moist areas
Stream Wheatgrass	Semi-moist to wet areas (seed rare)
Red Top and Smooth Brome	Waterlines and wet areas, large waterways
Creeping Red Fescue	Waterlines and met areas, small laterals
Cereal Rye	As a companion to crested wheat grass in light soils subject to wind erosion

Some special problems arise in selecting the grasses to be planted. For example, the seeds of certain grasses, if planted on ditches, may contaminate certified seed crops in nearby fields. Also several clovers suitable for waterline plantings are not used because their seeds are difficult to remove from alfalfa, red clover, and ladino seed crops.

Another problem is establishing grass stands in the lighter soils subject to erosion—the very place most needed. A partial solution is the seeding of cereal rye as a companion crop with crested wheat grass. A few weeks of fall growth of the faster growing rye largely prevents the crested wheat seed blowing out and protects the new seedlings. However, if wind erosion is not controlled on adjacent farm units, the ditchbank grass plantings may be doomed to failure.

The success of ditchbank seedings on the Columbia Basin Project has resulted in interest by the county and State in seeding road rights-of-way. On a trial basis, Grant County has seeded four miles of county road margins and the State Highway Department 50 miles of new highways in the Columbia Basin Project area.

The total accomplishment to date by the Bureau of Reclamation in the control of weeds by competitive grass seedings is impressive. This is especially true when one considers the problems which had to be solved concerning low rainfall, light soils, high winds, cold winters, rainless summers and the introduction of irrigation water as a new elment to the native environment. More than 5,000 acres of grass have been seeded on 1,100 miles of canals and laterals. Direct monetary savings are indicated generally by the fact that three-year-old grass stands have reduced by 60 to 75 percent the need for control by spraying.

The control of weeds by grass competition is well underway on the Columbia Basin Project. All the affected interests are joining as allies to meet the weed problem on all fronts. Control by grass from the outset goes a long way in solving the control of weeds. But continuued efforts are mandatory, and a united front the only ultimate answer. ###

Creeping red fescue at lower end of farm prevents loss of soil and consequent filling of borrow ditch. COMPARE WITH 8 WEED TYPE PHOTO, opposite page.

Streambank wheat grass provides competitive turf along waterline of small laterals. Crested wheat grass gives adequte protection on drier slopes of the ditchbnk.

Surplus Reclamation Crop Charges Answered

by W. A. DEXHEIMER
COMMISSIONER OF RECLAMATION

Commissioner Dexheimer discussed the surplus Reclamation crop charges at a luncheon meeting of the Alpha Zeta Agricultural Honorary Scholastic Organization in the Department of Agriculture, Washington, D. C. on November 17. A condensation of his talk follows:

MUCH HAS BEEN WRITTEN and more has been said regarding crop surpluses. A principal question these days is "Why should we develop additional irrigated farmlands in the face of current over-production"? Generalizations are often misleading. They are not only misleading—they result in gross misinformation which indicts reclamation as a principal contributor to these surpluses.

First, I would like to call to your attention some of the over-all considerations that have a bearing on the development of our agricultural resources. Then I will discuss the relationship of reclamation project production to crop surpluses.

Population in the United States is increasing at a rate which, a decade ago, would have been unbelievable. The Western States are gaining at a much faster rate than the rest of the country. Recent projections by the Bureau of the Census indicate a total population by 1975 of about 221 million (an upper limit of 228 million), and by 1965, only ten years hence, of 190 million.

Fifteen to 20 years ago our demographers were saying our population would level off during the 1950's and would decline after 1960. Less than ten years ago our population experts were saying that by 1975 we would reach 162 million. We have already exceeded that figure. The estimate for 1975 is just 50 million people greater than it was 10 years ago. It is not my purpose in calling attention to these estimates to belittle the demographers but to emphasize the tremendous actual and potential increase in population.

The Administrator of the Soil Conservation Service, Mr. D. A. Williams, in a recent speech before the National Reclamation Association, pointed out that more than 115 million acres are now occupied by cities, highways, airports, defense establishments, and for industrial use. Eighty million acres of this area were originally good farmland. Mr. Williams also pointed out that we are losing farmland to nonagricultural uses at a rate of more than one million acres per year despite any new acreage brought in by irrigation projects.

Dr. Byron T. Shaw, in recent testimony before Congressional Committees, said that if we are to eat an average of red meat annually, which was the consumption in 1954, we will require some 35 million acres more of land in 1962 than was used

in 1953 to grow feed. It has been variously estimated by responsible officials in the Department of Agriculture that a balance will be reached between production and consumption within about 3 to 5 years.

Other significant trends are in evidence also. The increasing population of the West is consuming more and more of the farm production of the Western States. Only a few years ago cattle raised we are to consume an average of 156 pounds of red meat annually, which was the consumption in in the Great Basin were shipped eastward. Now the line of demarcation between the East and West bound movement of cattle is generally, I believe, at about the Continental Divide, but with some Texas cattle moving to the west coast.

The increase in the per capita consumption of fruits and vegetables reflects a further change in our diet and eating habits. The irrigated West supplies a substantial part of the total requirement for these protective and health-giving foods, much of which is marketed during the late fall, winter and early spring.

In this perspective, consider that many years elapse between the time a Federal Reclamation project is first proposed and the time the lands are in full agricultural production. We must go through the extensive process of investigation, review of proposed reports by all interested State and Federal agencies, authorization by the Congress, the appropriation of funds for construction, the development of final plans and specifications, the construction of the physical facilities of the project, and finally the settlement of the land.

Even after the farmers are on the land, several years are necessary for the leveling and construction of farm ditches. On a project settled over an extended period from 5 to 25 years may be required to bring the total area served into full production. Projects or additions to projects which are proposed today will not come into full production for several years after we have attained a balance in overall production and consumption. Many of our projects supply supplemental water to an existing economy—that is, they assure water year after year to stabilize production.

The principal price support crops on which there is some production on reclamation projects are barley, corn, oats, wheat, rye, grain sorghum, cotton, dry and edible beans, flaxseed, rice and soybeans. The cereal grains are grown primarily for feed and to provide a balanced farming operation, including the rotation of crops for maintenance of soil structure and soil fertility.

Data obtained from the Department of Agriculture show by States the 1954 production of each of these crops under the support program. The amount of production which is actually price supported varies from 5 to 50 percent. Using the percentage of production supported in each State, we have estimated the amount produced on reclamation projects which might be considered supported. The total production of each cereal crop on Reclamation projects in 1954, as a percentage of United States production, varies from about one-sixth of 1 percent to about 7.5 percent. Thus, when you take into consideration the relatively small portion of each total crop which is price supported, it becomes clearly evident that support for Reclamation project production is negligible and of little significance.

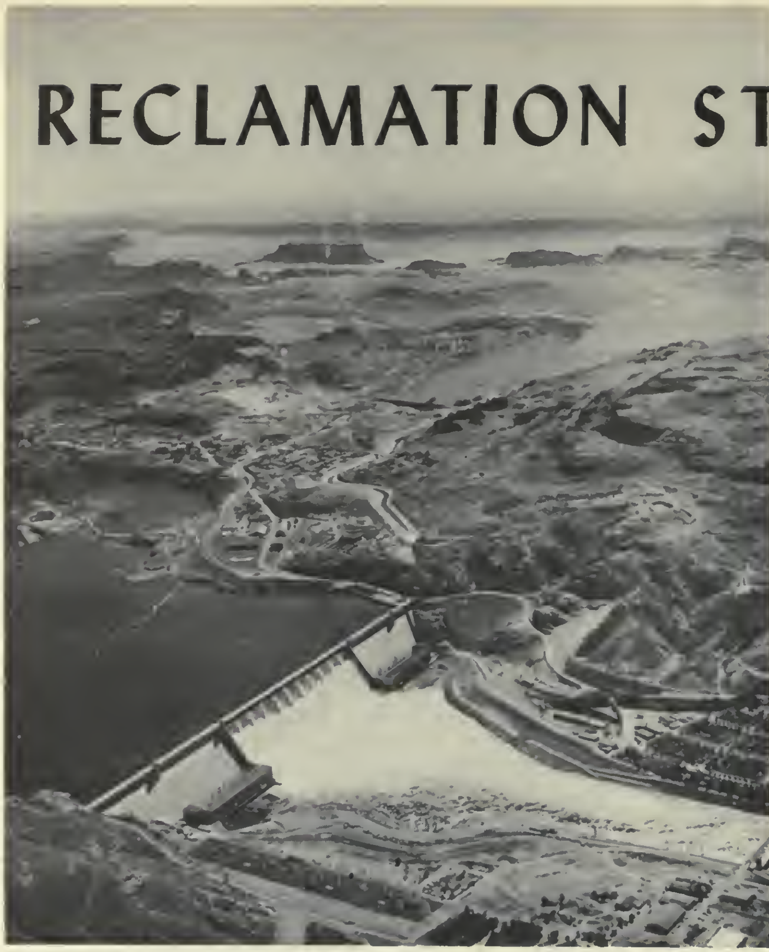
Many Western irrigation projects are in close proximity to large public grazing areas. These cereal crops supplement the grazing lands and permit better utilization of the 700 million acres of western rangelands by providing a late fall, winter and spring feed supply. Grazing of many acres would not be economically feasible by reason of high transportation costs of livestock to and from grazing lands were it not for these irrigated feed base lands.

We hear a great deal about how wheat production on Reclamation projects is in competition with midwestern wheat. Wheat produced on Reclamation projects in 1954 was less than 2 percent, and the amount supported was less than 1 percent of the United States production of about 970 million bushels. This is hardly a major contribution to the problem of over production of wheat. Actually, instead of contributing to that problem, farming as practiced under irrigation tends to alleviate this problem.

In Washington State we are building the Columbia Basin project. Facilities are being completed each year to serve an additional 50 to 60 thousand acres with irrigation water. In the principal counties in which the project is located, approximately *92 percent of the cropland* was used for dryland wheat in 1950. The acreage harvested was 45.6 percent, indicating the amount in summer fallow to be about equal to that har-

Continued on page 24

RECLAMATION STRUCTURES AMONG SEVEN MODERN WONDERS -A.S.C.E.



Two Bureau of Reclamation projects, Grand Coulee Dam of the Columbia Basin Project, and Hoover Dam were recently named among the "Seven Modern Civil Engineering *Wonders* of the United States" by the American Society of Civil Engineers' Committee.

Interior Secretary Douglas McKay said that he was particularly impressed with the criteria established by the Committee which stressed service to the well-being of people and communities. The Secretary stated further that the selection of these projects is a fitting recognition of engineers who have made the Bureau of Reclamation a world renowned authority on hydraulic planning and construction.

During the ASCE's Centennial Year (1952), its Local Sections were encouraged to select the seven civil engineering wonders of their respective areas. Selections were made and publicized by many Sections, representing considerable thought and effort by a large number of members of the Society. At is October 1954 meeting the Board of Direction gave further consideration to this matter and empowered President Glidden to name a committee to examine the local choices already made, to make a national selection of the seven modern civil engineering wonders in the United States, and to report its recommendations to the Board.

The following members served on the Committee: Waldo Bowman, New York; Vice President Louis Howson, Chicago; Past President Malcolm Pirnie, New York; Past President Daniel V. Terrell, Kentucky; Ralph A. Tudor, San Francisco; and J. Kip Finch, New York, Chairman. Mr. Bowman and Dean Finch are former Directors.

After months of deliberation, during which careful consideration was given to 33 projects designed and built by civil engineers, the Committee recommended, and the Board of Direction concurred in, the selection of the following: Chicago's Sewage Disposal System; the Colorado River Aqueduct; the Empire State Building; the Grand

Coulee Dam and Columbia Basin Project; Hoover Dam; the Panama Canal; and the San Francisco-Oakland Bay Bridge. The order in which these projects are named is alphabetical and has no other significance.

GRAND COULEE DAM is unique in being the largest concrete structure in the world, and is the spectacular feature of the million-acre multi-purpose COLUMBIA BASIN PROJECT.

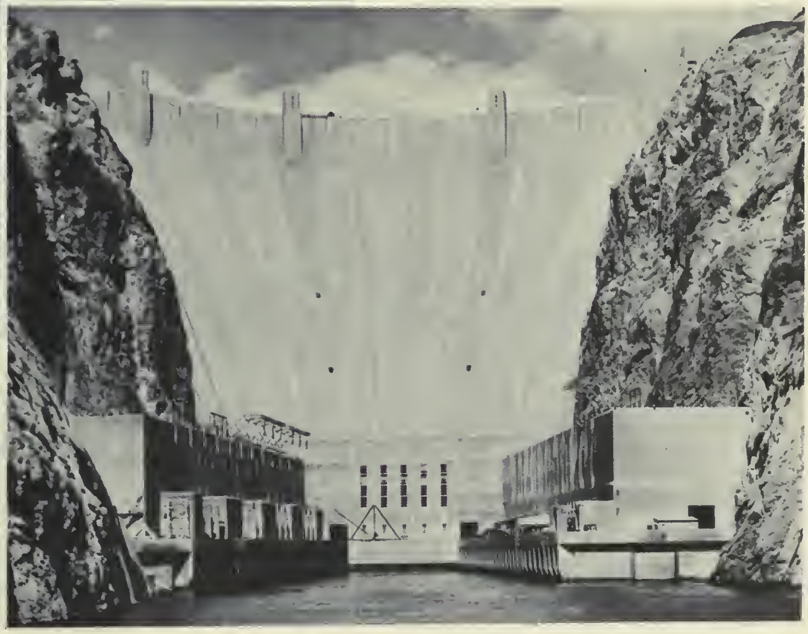
The Dam is 92 miles west and north of Spokane and 240 miles east of Seattle. It is 4,173 feet long, stands about 370 feet above the surface of the Columbia River, contains 10½ million cubic yards of concrete, and weighs about 22 million tons. Its height from lowest bedrock is 550 feet, nearly half its volume being below the river surface.

The central spillway is 1,650 feet wide, and the waterfall over it is half as wide and twice as high as Niagara Falls. The dam created the Franklin D. Roosevelt Lake, a reservoir extending 151 miles from the structure to the Canadian Border. Grand Coulee will ultimately provide water for irrigating about a million acres, an area larger than the State of Rhode Island. It also involves the largest hydroelectric power plant in the world with 18 main generators and 3 service generators, having an installed capacity of 1,974,000 kilowatts. Part of this power output is used to pump water to irrigate lands which are located above the river. These centrifugal pumps are the largest in the world and one of them is large enough to pump the water requirements of the City of New York.

Power from Grand Coulee Dam is distributed chiefly through substations near Portland, Seattle, and Spokane to industrial plants and to private and municipal power utilities by the Interior Department's Bonneville Power Administration, which built and operates the Government transmission system in the Pacific Northwest.

Pioneers homesteaded much of the Columbia Basin Project area of eastern Washington in the late 1800's. After a succession of dry years many settlers left the region. Those who remained concentrated their attention on irrigating the dry

THE PULSE OF A CIVILIZATION, above Hoover Dam's giant generators, source of electric "juice" that lights large Southern California metropolitan centers. *Department of the Interior Photo.*



HOOVER DAM as seen from the tailrace, below. Power houses on either side of the river are 20 stories high. Water behind the 726 ft. dam is rising over 400 ft. above level of tailrace.

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Columbia Plains with water from deep artesian wells. In 1904, the U. S. Reclamation Service investigated the possibilities of land along the Columbia River in Grant, Adams, and Franklin Counties in Eastern Washington. However, it was not until innumerable additional investigations, reports, and studies had been made that construction was begun on the project, almost a generation later in 1934. The first power went on the line in 1941 and irrigation water became available in 1948.

Grand Coulee Dam, once referred to as a "white elephant" was destined to justify its backers when it proved the main source of sorely needed power for defense industries which sprung up in the Pacific Northwest during World War II.

The year 1955 has been one of progress in the Columbia Basin in agriculture and in the growth of its cities. Four hundred and ninety-six farms were irrigated in 1952, with a farm income of $4.6 million. In 1953, 1153 farms were irrigated to bring a farm income of $9 million. Columbia Basin farm income for 1954 was in excess of $16 million, an increase of more than $7 million over the 1953 figure. Water was delivered to 1846 farm units in 1954. Dollar turn-over of farm income in the last three years of operation is more than $30 million. Increase is expected to continue at a like rate for the next few years.

When the Columbia Basin Project is completed it is estimated 14,000 farms will bring an annual dollar turn-over of $600 to $700 million to the Basin and the Pacifiic Northwest.

Some of the major crops raised in the basin were 34,542 acres of dry beans, 9,059 of potatoes; 862 of onions; 8,253 of sugar beets; 1,245 of peas; 9,075 of alfalfa; 2,098 of other hay; 2,969 of pasture; 4,544 of field corn and sorghums; 11,951 of wheat; 3,705 of oats, barley and rye; and a few acres each of specialty crops, such as vegetable seed, mint, cantaloupes, watermelons, and flower bulbs.

The Columbia Basin will continue to grow as more and more land is irrigated during the next few years. As one observer said, "We think we are busy now, we think the area is pretty well settled . . . but we ain't seen nothin' yet compared to what it will be."

HOOVER DAM, formerly Boulder Dam, is the principal engineering structure of the multi-purpose Boulder Canyon Project. The dam, highest in the world, stands 726 feet and is located in the Black Canyon on the Colorado River, Arizona-Nevada.

It is 1,244 feet long at top, contains 4,400,000 cubic yards of concrete. Its reservoir, Lake Mead, extends 115 miles upstream and has a storage capacity of 29,827,000 acre feet and is the largest artificial lake by volume in the world.

In the U-shaped Hoover Dam power plant there are 18 generators, having a total capacity of 1,249,800 kw, driven by turbines totaling 1,742,000 h. p. The installed capacity is sufficient to supply the normal domestic needs of 7,500,000 persons. The United States has executed contracts for disposal of all firm and secondary energy generated at the plant until 1987, the end of the amortization

Continued on page 24

WORLD CROSSROADS IN A DESERT—A strip of dark blue water—Lake Mead, one of the world's largest man-date lakes, stretches 115 miles above Hoover Dam creating a startling contrast with the arid rugged countryside along its shores. ***Department of the Interior Photo.***

THE WHITE HOUSE
WASHINGTON

Denver, Colorado
October 17, 1955

Dear Mr. Peterson:

Please convey my greetings to the members of the National Reclamation Association on the occasion of your Twenty-fourth Annual Meeting.

An increasing urban population, expanded irrigation and industrial needs, and recurring drought conditions have helped make us all aware that we must work toward the maximum practicable use of our water. To accomplish this objective, it is essential that the Federal Government, States and local groups work together.

We must continue to foster local and regional enterprise in the irrigation field. But there are also multi-purpose projects -- such as Upper Colorado, Fryingpan-Arkansas, and Trinity -- that involve financing which, in part, can be carried successfully only by the Federal Government. Such projects require major Federal participation.

Your organization has been among the foremost in promoting sound conservation practices and the wise use of our water resources. With my personal felicitations to you, I extend to all its members my best wishes for a successful convention and for continued contributions to the prosperity and welfare of the nation.

Sincerely,

Dwight D. Eisenhower

Mr. C. Petrus Peterson
President
National Reclamation Association
Lincoln, Nebraska

Report on *International Arid Lands Symposium*

by R. S. BRISTOL, Assistant To The Regional Director Bureau of Reclamation Region 5, Amarillo, Tex.

RIVER-SIZED CANALS like this bring irrigation water to thirsty acres in the West. ***Bureau of Reclamation photo.***

A series of meetings were held in Albuquerque and Socorro, New Mexico, from April 26 to May 4, 1955, that were unique in the history of the modern world. Sponsored by the Committee on Desert and Arid Zone Research of the Southwestern and Rocky Mountain Division of the American Association for the Advancement of Science and the Advisory Committee of the United Nations Educational, Scientific and Cultural Organization, these meetings were the first attempt to lay the groundwork for an organized and orderly approach to solving the problems of making practical use of desert lands throughout the world.

More than 500 scientists representing Iran, Mexico, Israel, Australia, Pakistan, France, Egypt, Philippines, England, India, Brazil, Chile, Italy, the Gold Coast, Lebanon, Syria, Netherlands, Thailand, Ethiopia, Nicaragua, Iraq, Canada, Honduras and Sweden traveled to the gathering. The United States as the host country had the largest representation. Four technical sessions, an all-day summary in 15 discussion groups, and a special symposium on problems of the Upper Rio Grande as an example of an Arid Zone Watershed were held in Albuquerque from April 27 to 29. Later, approximately 90 of the delegates made a field trip through the Estancia Valley, White Sands Proving Grounds and over the Rio Grande Project and the San Marcial Channelization Project of the Middle Rio Grande Project. On April 30 the final three-day session began at the New Mexico Institute of Mining and Technology at Socorro.

The opening sessions at Albuquerque were devoted to a description of the varied arid land problems existent in the countries represented. Suggestions for the solution of these problems were given major attention by the conferees and were summarized carefully in order to develop a central point for future action.

Items discussed in the technical groups were of particular interest and the varied topics are well illustrated by the questions treated by various speakers.

Under the chairmanship of Reed W. Bailey, Director, Intermountain Forest and Range Experiment Station, one group of scientists discussed the "Variability and Predictability of Water Supply in Arid Regions."

A session presided over by Kanwar Sain, Chairman, Central Water and Power Commission, Ministry of Irrigation and Power, New Delhi, India, considered the subject of "Better Use of Present Resources." The questions discussed under this topic were most interesting. "What are the possibilities of increasing and maintaining sustained production from grass and forest lands without accelerating erosion? What are consequences of utilizing arid lands beyond their capabilities? What constitutes wise allocation of available water supplies among the various needs in arid land drainage areas? How can production be increased from existing water supplies? Can irrigated lands be occupied permanently?

"Prospects for Additional Water Sources" was a timely subject debated under the chairmanship of E. J. Workman, President, New Mexico Institute of Mining and Technology, Socorro, New Mexico. Consideration of this topic was divided into four phases. "How practicable is it to induce precipitation? How practicable is it to demineralize saline water? How practicable is it to reuse waste waters? What are the social and economic implications of these programs?

Another most interesting topic "Better Adaptation of Plants and Animals to Arid Conditions" was discussed under the leadership of Olaf S. Aamodt, Technical Specialist, Plant Sciences, Agricultural Research Service, Beltsville, Maryland. The questions considered in developing this subject were most thought-provoking. "What screening procedures would lead to the selection of more productive plant and animal species for arid regions? What are the genetic and physiological bases for drought resistance in plants and animals? What are the prospects of increasing drought resistance through genetic research? How can we develop a program of revegetation? What are the economic possibilities in the development and utilization of arid land plants and animals? What are the possibilities of maintaining larger human populations in arid areas?"

One of the principal speakers in the Section devoted to Better Use of Present Resources was L. N. McClellan, Assistant Commissioner and Chief Engineer of the Bureau of Reclamation, Denver, Colorado. He began his address by reviewing the development of the arid Western United States showing that much of this progress was due to the use of irrigation water. He stated that further progress will be increasingly difficult and constitutes a challenge to the ingenuity of

L. N. McClellan

R. S. Bristol

A. Nelson Sayre

John L. Gregg

mankind. The allocation of water between primary and secondary uses comes about more or less naturally as human consumption will always be given priority with industrial and agricultural uses in a secondary position.

Mr. McClellan stated that data show that about one-third of the total stream runoff in the Western United States can properly be used for irrigation and at present only about one-fifth is used for this purpose. He continued by stressing the need for increasing the use of surface and ground water storage and that the former is the prime means of developing and utilizing our surface water supplies. We must have adequate regulation of erratic flows from intermittent precipitation.

He emphasized the length of time necessary for orderly planning and construction of water conservation works stating that the Columbia Basin Project is a good example.

His review of our population growth, especially in the West showed the increasing need for domestic water. He touched on the opinion of some people that the use of water for irrigation is wasteful, stating that we feel it is justified by the increased production of food and fibre and consequent increase in national wealth. The lands on Bureau of Reclamation projects, about one-fourth of the irrigated lands in this country, produced crops valued at $786,000,000 in 1953. Storage structures for irrigation also provide important benefits in power development and for flood control.

Mr. McClellan then turned to the problem of increasing water production from existing supplies. He stated that we must try to do several things: put to use water not now used, make better use of water now used, and improve the quality of water.

In transporting water in irrigation canals, often one-half of the amount diverted is lost through seepage, evaporation and other nonbeneficial uses. This should be corrected. In the six years ending

CARROT WASHING OPERATIONS at a produce concern in Nampa, Idaho. ***Photo by Stan Rasmussen, Region 1.***

in 1952, about 25 million square yards of linings were placed in more than 750 miles of canals and laterals on Federal reclamation projects, saving an estimated 700,000 acre-feet of water annually. He stressed the fact that excessive weed growth in canals increases losses due to seepage and transpiration. Water must be used and reused by industry, even though the cost is high.

He mentioned the saline water research program being carried on by the Department of the Interior, both on sea water and saline waters of the Interior, including reuse.

To illustrate the growing shortage of water he stated that the City of Colorado Springs recently offered to buy water from irrigators at the rate of $350 per acre foot. He showed that cities must encourage residents to economize on water use and that more rigid regulations would doubtless be required, including expensive treatment of industrial waste and sewage effluent. Another avenue of research is to determine the minimum quantity of water required to produce maximum crops. He estimated that 500,000 acre feet of water could be salvaged by increased efficiency in water use on our irrigated lands.

He asserted his belief that irrigation can be continued indefinitely if two factors are kept in mind: adequate drainage and ample reservoir storage with sufficient allowance for sediment accumulation.

Mr. McClellan concluded by stressing the need for broader and more comprehensive planning for resource development and stated that quick and inexpensive exploitation must be stopped. He plead for broad cooperation by all concerned in order to achieve maximum use of resources.

A special symposium on "Problems of the Upper Rio Grande" under the chairmanship of Dr. A. N. Sayre, Chief, Ground Water Branch, Geological Survey, Washington, D. C. covered some eight phases relating to conditions in this area and as exemplifying the status of similar areas throughout the world. Two other speakers represented the Bureau of Reclamation and one presented the ideas of a Reclamation water-user organization in describing special problems in this area.

Mr. John C. Thompson, Project Manager of the Middle Rio Grande Project, showed the reason for present conditions by outlining the history of irrigation in the Middle Valley. He pointed out that some of the lands were being irrigated when Coronado came in 1540 and that maximum development of the area was reached in 1880 when about 125,000 acres were under development. He described the critical condition existing at present and presented data showing that runoff on the

Continued on page 26

MR. CORBELL and INTERIOR SECRETARY DOUGLAS McKAY. ***Photo by Bob McKay, courtesy of the Lincoln Star, Lincoln, Nebr.***

SALT RIVER'S FINAL PAYMENT

by VICTOR I. CORBELL, President, SALT RIVER VALLEY WATER USERS' ASSOCIATION

Editor's Note: For your information we are publishing a verbatim account of Mr. Corbell's remarks before the recent National Reclamation Association's 24th Annual Convention at Lincoln, Nebraska, where he presented the Salt River Project's check to Secretary McKay.

Mr. Peterson, Secretary of the Interior McKay, Commissioner Dexheimer, Honored Guests and Members of the National Reclamation Association:

It is a real honor to represent the oldest multiple purpose reclamation project, the Salt River Project, and bring you greetings from the Valley of the Sun in Arizona.

The Salt River Project has the distinction of being the first multiple purpose project that reclamation built. It was authorized in 1903 under the Reclamation Act and Roosevelt Dam was completed in 1911 at a cost of $10,166,000. It was dedicated in the same year by the late Theodore Roosevelt for whom the dam was named. I had the pleasure of attending the dedication, and little did I think then as a teenage boy that I would sign a check as president of the Salt River Valley Water Users' Association to make the last payment on the original construction cost of this project.

Much has been said about the Reclamation Bureau in the past few years, some critical and some in praise.

Now that we are completing our repayment contract on the original construction cost, perhaps we should analyze what reclamation has done for our community.

I shudder to think what our Valley of the Sun would be today had the Reclamation Bureau not built this great project. No one could tell what progess we would have made had it not been built, but I can tell you what we had before it *was* built.

Irrigation isn't new in our Valley. The Hohokam Indians lived in this Valley, and raised crops by irrigation in 300 B. C. They had an elaborate system, and it is estimated that their population exceeded 10,000 people. After many years of off-and-on prosperity here, the waterlogging of the land and drouth drove the Hohokam Indians out. When white men came in the 1860's the ruins of the Indian villages and their canal system were very evident. In fact many of the canals used today follow the exact lines of the old Indian canals.

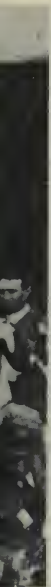
The early white settlers soon encountered the same problem that had plagued the Indians down through the centuries—*DROUTH.* The river was very erratic—most of the year a mere trickle of water flowed between its banks but occasionally great floods would come rushing from the mountains, tearing away the brush dams and washing away the headings of the canals of the early settlers, and dumping millions of acre-feet of water into the Gulf of California. When the diversion dams of rock and brush were restored the river had receded to a trickle again.

Nature caught up with white men just as it caught up with the Indians. Many of the settlers moved away.

With the building of the multiple purpose Roosevelt Dam, with its hydro-electric generation, the problems of these early pioneers were finally solved. It gave an adequate, controlled supply of water and furnished electricity for pumping the water from the underground, relieving the waterlogged condition and also augmenting the irrigation supply. Water and power go hand in hand with agriculture and industry, creating an unbeatable economy.

Let us compare what we had then and what we have today—

In 1910, just before the Project was completed, the assessed valuation of all land in Maricopa County was $17,800,000; in 1955 the assessed valuation shot up to $359 million. In 1910 crop production in Maricopa County approached $3 million; in 1954 more than $57 million was realized from crops raised within the Project alone. More than $1 billion worth of food and fiber has come from the Salt River Project since the completion of Roosevelt Dam. Where there were 15,000 people in Maricopa County in 1910; there are now 500,000. Last year bank clearings in Phoenix totalled almost $4 billion, and retail sales amounted to $537½ million. Since 1922 the Project payroll has amounted to $67 million. The Project has also paid $21 million in interest on bonded debt to people all over the United States, and has con-



Far left: AN EXAMPLE OF NEGLECT in the San Simon Valley. Next, PRESIDENT THEODORE ROOSEVELT at the dedication of Roosevelt Dam, March 18, 1911. At left, ROOSEVELT DAM. Below, FLOURISHING CITRUS grove in Salt River Valley made possible through irrigation. *First and last photos by Wm. S. Russell.*

structed a plant valued at $78 million. That briefly is what the successful Salt River Project has meant to Arizona and the Southwest. Now, what has it meant to the Nation?

With the production of food stuff alone, the Project has joined with the other reclamation projects to virtually revolutionize the American menu. Americans are the best fed people on earth, and the Valley of the Sun makes its contribution with a prolific production of vegetables and fruits. At a time when most of the country's producing areas lie deep in snow—fresh lettuce, carrots, cab-

HONEY DEW MELONS ready for market at lower left: BALING ALFALFA HAY near Tempe, Ariz., center: DATES RIPENING in Salt River, right.

bage, onions, dates, pecans, grapes, oranges and grapefruit are a few of the items that flow out of the Valley to the Nation's tables—beef, mutton, cotton, and grain are also shipped from the Valley to the markets of the world.

This export of important food products is only half the story. A tremendous market is created within the Project boundaries for goods produced in other states. For instance, our lettuce farmer may fertilize his ground with phosphates from the southern states, use a tractor made in Wisconsin, gasoline refined in Texas, a disc or gang plow made in Illinois, a pump from Ohio, a motor from New York, a transformer from Indiana, nails from Pennsylvania, box-making machinery from California, paper from Tennessee, a truck from Michigan, ice-making machines from Illinois or Iowa. He then loads his product into a freight car fabricated by a dozen manufacturers in different eastern areas.

In dollars and cents, however, we find the most astounding returns. You must remember that the original investment of the Government in the Salt River Project was a loan of $10,166,000. From the original investment, 1/7 of the cost of a battleship, the United States has received in income and excise taxes from Maricopa County alone, more than $609 million since 1934—a 6,000 percent return on its investment in 20 years.

There are those who insist in loud and sometimes effective voice that reclamation does not pay; that irrigation projects must be subsidized by the taxpayer, and even the most successful projects cannot pay their own way. There are those who claim there is too much land in cultivation now; that our surplus crop holdings threaten the future of the Nation's economy. These are the same prophets of doom, the advocates of scarcity, who never can face facts. These people recommend the abandonment of reclamation; that we discontinue building more reclamation projects; that we let food and fiber production catch up with consumption. It takes years to build these reclamation projects and we would be in a sad state of affairs if we sat idly by and let the population increase faster than our food and fiber production. Having too much is a much better position to be in than having too little.

Without reclamation this rapidly expanding economy would have been impossible. Its very foundation is made secure by the conservation and efficient use of our water. Therefore, Mr. Secretary, on behalf of the 50,000 shareholders of the Salt River Valley Water Users' Association, I want to demonstrate, here and now, that the Government's faith in the Salt River Project has not been misplaced; that every dollar invested is repaid.

I take great pleasure in presenting to you this check for $159,500.10. This is the final payment to the United States on the original $10,166,000 loan to the Salt River Valley Water Users' Association, and is proof positive that reclamation pays its way.

The citizens of our Valley will be eternally grateful to the United States Government for making this great project possible. ###

LIVESTOCK, Salt River Project.

LETTUCE CROP, Salt River Project.

RECLAMATION'S HALL OF FAME

Nomination No. 20

J. M. DILLE

by GEORGE A. EPPERSON, Attorney-at-Law
Fort Morgan, Colorado

John Marr Dille is a "ramrod"—a man who gets things done. It's the good fortune of the Northern Colorado Water Conservancy District to have him as its manager.

Able, devoted, quiet and conservative, a solid citizen who proceeds soundly rather than spectacularly, Dille has been the push behind the Colorado-Big Thompson Project, from the irrigators' aspect, for the last 20 years.

Now, approaching 80, he can watch the last dirt moved on the last supply canal that this spring will complete the $159 million job. District residents can be deeply grateful for the services to them by "the man from Fort Morgan" in bringing the project to this point.

Dille has been Secretary-Manager of the District since its formation in 1937, and for the two years previous he was manager of its predecessor organization.

Charles Hansen, esteemed Greely newspaper publisher who died in 1953, was president of both organizations. The two made an extraordinarily effective team, working with a large number of northern Colorado community leaders who also supplied drive and determination to get the project. Hansen was the great public leader and Dille was his right-hand man—the doer—through the difficult period of project development. Hansen was the superb strategist, Dille the master diplomat and craftsman.

Dille had accomplished a full and successful career as an irrigation district manager even before the Colorado-Big Thompson development began. A native of Denver, he was a farmer before he went to Fort Morgan, Colorado, in 1910 to be the first superintendent of the Riverside Irrigation District. The Riverside, its works sprawling for 70 miles along the South Platte River, had as many and as serious problems as any other large district but is one of the few whose bonded indebtedness was cleaned up without dissolution or litigation.

His management of the Riverside was so successful that the Bijou Irrigation District, across the river, arranged in 1924 for him to become its super-

intendent, too. For the Bijou he devised a "credit and debit" system of delivering water under the complications of a long ditch carrying many different types of water. The system was legally challenged, and ultimately the Colorado Supreme Court gave it complete approval.

So thorough was Dille's knowledge of the South Platte that he could quote the priority date, diversion rate and capacity of each adjudicated priority on the main stem.

As a leader among irrigationists, "the man from Fort Morgan" naturally participated in the first discussions when the plan to divert surplus Colorado River waters into the South Platte basin began to stir.

The twin scourges of drought and depression had descended on the South Platte area in the early 1930's. The need for supplemental water from across the mountains had long been known, but the obstacles—political, legal, and financial—seemed as high as the mountains themselves.

Someone had to raise money for preliminary feasibility surveys, and to figure out construction financing. Someone had to tour the valley and satisfy the public demand for information about construction plans, costs, methods of financing and potential benefits. Someone had to allay the fears of Colorado's western slope about the effects of diversion and determine a fair means of settlement.

Dille was in the middle of all of these essential preliminary tasks and many others. This would be quite an assignment for any man, but it was particularly so for the quiet, reserved person who, in spite of his capabilities, had never before been called upon to address public gatherings; who had not had occasion to talk to heads of rail and industrial corporations, much less to obtain money donations from them. Yet Dille became both forceful and lucid in his presentations.

It is testimony to his adaptability and to the caliber of his performance that the South Platte Valley was wholeheartedly sold on the proposals. The valley's engineering survey led to the Bureau of Reclamation's project report, completed in 1937.

An entity was required that would have the

GROUP PHOTO on preceding page—Directors and Officers of Northern Colorado Water Conservancy District at Signing of Repayment Contract with U. S. for Construction of Colorado-Big Thompson Project. Standing L. to R.: *Fred Norcross, *Burgis G. Coy, Robert J. Wright, Robert C. Benson, *William A. Carlson, Ralph W. McMurray, Ray Lanyon, Ed. F. Munroe, *Moses E. Smith, Wm. E. Letford, *Chas. M. Rolfson. Seated L. to R.: *Thos. A. Nixon, *Chas. Hansen, and J. M. Dille. *Deceased. *Photos courtesy of Mr. Dille.*

power to contract with the United States for construction repayment under reclamation law. The Northern Colorado Water Users Association, established in 1935, accordingly sponsored and obtained passage of the Colorado Conservancy District Act of 1937. Dille contributed a great deal to the drafting and passage of this act. Further, it became his task to organize and complete the district, establishing its boundaries and obtaining thousands of signatures of property owners.

When the association directors held their organization meeting to form the Northern Colorado Water Conservancy District in 1937, they named Dille as its manager, and he resigned from his dual superintendency of the Riverside and Bijou districts to devote full time and effort to the new enterprise.

(In the same year, the Colorado Water Conservation Board was created to protect and develop the State's water resources. Dille was appointed by Governor Teller Ammons to represent the South Platte basin on the board. As a personal friend and advisor, he rendered valuable service to the board's nationally known director, the late Clifford H. Stone. He served on the board for 15 of the last 18 years, and performed memorable service to the State.)

The new conservancy district's first task was to negotiate the repayment contract with the Bureau of Reclamation for the irrigation features of the Colorado-Big Thompson Project. By the overwhelming majority of 17 to 1 the tax-paying electors approved the contract negotiated by Dille and others.

When Dille assigned tasks to others, they dared not delay because he followed up assignments with diligence. The plans, operations and procedures of the Northern Colorado Water Conservancy District are indelibly marked with that quality of native "know-how" so characteristic of J. M. Dille.

Through all the years, Mrs. Dille has maintained the family home at Fort Morgan. Their three sons reflect credit on them and their dignified family life. John is a "Life" magazine foreign correspondent, Gordon is an electrical engineer with Westinghouse, and Deane is a Denver florist.

To the man who dedicated himself to the accomplishment of a great task, the present and future citizens who will benefit from his efforts owe a resounding "Well done!" ###

L. to R.: Jesse Watkins, Asst. Superintendent; Trinidad Montoya, Operator; Rufus Stroud, Superintendent; and Albert G. Simms, Owner. *Photo courtesy of Mr. Simms.*

Where Corn is King

by WAYNE S. SCOTT

> Editor's Note: We are indebted to the Albuquerque Journal for the following article which appeared in the October 23, 1955, issue of the Journal in the Farm and Ranch column.

Farmers of Iowa and other states proud of their tall corn had better look to their laurels.

The corn crop at Los Poblanos Ranch this year is outproducing practically anything in the corn states. The yield from one acre—carefully measured and harvested under direction of County Agent C. A. Grimes—weighed out at 169.71 bushels. That compares with 52, 50 and 49.7 bushel 10-year averages for the states of Illinois, Iowa and Indiana, respectively, and the national long-time average of 35.7 bushels to the acre. The 1955 New Mexico yield has been estimated to average 16 bushels per acre, including both irrigated and dry-land corn.

Grimes says the crop "points up the potential yielding ability of the Middle Rio Grande soils where fertility levels are sufficiently built up and where good management practices are followed." He attributes the high yield to fertile soil, an adequate supply of irrigation water and good management.

The corn field is west of Rio Grande Blvd. and north of the dairy barns of Los Poblanos. Building up of the soil has been underway almost ten years. The particular field was an irrigated pasture from 1946 through 1950, was in oats in 1951, and in irrigated pasture again from 1952 through 1954.

When the field was plowed this spring, it was fertilized with 150 pounds of superphosphate and ten tons of manure to the acre. The land was pre-irrigated on May 18. The corn—a hybrid strain known as Funks G91—was planted May 25. An excellent stand was obtained, with plants about eight inches apart in rows 40 inches apart. The field was irrigated seven times during the growing season, and fertilized twice.

One fertilization was immediately after the first cultivation, when 100 pounds of anhydrous ammonia was applied as a side dressing. When the corn was in silk, another 70 pounds of anhydrous ammonia was applied in the irrigation water.

The corn was dusted with a mixture of 40 pounds of dusting sulphur and 5 pounds of 50 percent DDT per acre, to control red spider, the Southwestern corn borer and corn earworms.

The corn crop will be used in the ration of the Los Poblanos dairy herd. ###

FRANK A. BANKS Honored by ASCE

Frank A. Banks, of Coulee (right), receives from Past President William Roy Glidden, of Richmond, Va., the highest distinction of the American Society of Civil Engineers, Honorary Membership, at its October convention in New York. The citation read:

"The American Society of Civil Engineers confers Honorary Membership on Frank A. Banks, world-renowned engineer and pioneer staff member of the Bureau of Reclamation, in recognition of his services to mankind in the building of great dams and the development of the water resources of the earth." *Photo by National News and Illustration Service Inc.* (For Mr. Banks' biography, see Reclamation's Hall of Fame Nomination No. 10—*The Reclamation Era* July 1950, page 130).

CREDIT

The photograph of Charles S. Willfoung in the article "Disabled Display Ability," page 83, November issue of the *Era* was taken by *F. S. Finch, U. S. Bureau of Reclamation.*

Butcher Paper Mural Heads Columbia Basin Project Exhibits

The Ephrata Schools were hosts to 200 teachers who attended the Eastern Washington Social Studies Conference held on November 4–5, 1955, at Ephrata, Washington. A 12 by 27-foot mural on butcher paper was the feature attraction in a gymnasium filled with exhibits prepared by children from the first grade to the senior year in high school. The exhibits were built around the theme, "The Columbia Basin—Yesterday, Today, and Tomorrow".

The mural was spray painted in appropriate colors on strips of butcher paper pasted together. The paper was pasted together and painted on the stage floor. It was then raised and hung to fill the opening on the stage. Grand Coulee Dam, a canal, sagebrush land, and new irrigated land were featured in the mural.

An estimated 3,000 persons viewed the exhibits at the public showing over the weekend. W. E. (Brownie) Walcott, Bureau of Reclamation Geologist and popular local speaker, and Frank T. Bell, Columbia Basin pioneer and advocate of irrigation in the West, were the principal speakers at the special meetings attended by the visiting teachers. #

BUTCHER PAPER MURAL portraying Columbia Basin Project was created by Ephrata High School students, in the picture, L. to R.: Larry Boyd, Lorraine Lebfeldt, and Byron Davis. ***Photo by courtesy of the Wenatchee Daily World.***

Reclamation Pioneers in Fish Conservation Techniques

by ROBERT D. GOODIER, Regional Design and Construction Division, Region 2, Sacramento, Calif.

A feature of the Central Valley Project now under construction is a unique structure for removing fish from the waters approaching the world's second largest pumping plant—The Bureau of Reclamation's Tracy Pumping Plant on the Delta-Mendota Canal. The screening of the fish is to be accomplished not by the conventional methods of utilizing wire mesh screens but by employing what might be likened to a venetian blind set vertically in the stream.

If all the fish in a river flowing at about 4,000 cubic feet per second were one inch or smaller and you were told to remove these fish without appreciable mortality, how would you acomplish such a feat? This was the problem facing the Bureau of Reclamation before the Tracy Pumps could go into operation. Young salmon and bass are the important fish encountered at the Tracy Pumps. Their natural instinct is to drift with the stream flow to the ocean. The young salmon are swept to the ocean by the early spring runoff. An increasing portion of this runoff will, in future years, be diverted by the Tracy Pumps. Consequently more salmon will be diverted from their route to the ocean. The bass are born in the Delta of the Sacramento and San Joaquin Rivers in the late spring and early summer months. They spend their formative days drifting with the flow of the tidal waters eventually finding their way to the ocean. These young bass occur in the Delta simultaneously with the peak water demands of the Central Valley Project. At this time, the flow to the Tracy Pumps may be nearly twice the flow to the ocean attracting a large portion of the bass population to the pumps. To conserve these fish it is essential that they be removed from the stream and transported beyond the influence of the Pumping Plant to a point where their natural journey to the ocean may continue.

Insofar as is known a problem of this nature had never before been encountered anywhere. Little was known as to how these fragile young fish could be safely "strained" from waters destined to irrigate farms of the San Joaquin Valley. It was therefore decided to build a temporary screen structure, utilizing the best information currently available, on which studies could be made to determine the best design for a permanent structure. The Bureau of Reclamation and the U. S. Fish and Wildlife Service then entered into a cooperative agreement whereby members of each organization conducted over four years of research on the problem. The California State Department of Fish and Game assisted in the research.

During the first two years of operations low pumping demands failed to attract sufficient fish for adequate experimental work. It also became obvious that the temporary structure would not function as designed. Alterations were made to improve its effectiveness. It also became apparent that more basic investigations concerning the reactions of the fish to screens were necessary. Observations of the fish in the murky waters of the Delta were impossible. Therefore, these studies were conducted with filtered river water in a small flume.

What is the swimming speed of these young fish? What is their endurance? These were two of the basic questions for which answers were sought by experiments in the test flume. The flume also served to test new ideas for screening the fish. A new idea was tested, that of using a vertical louver weed deflector which had been tried at turnouts in a San Joaquin Valley irrigation canal. The louvers were not satisfactory for diverting weeds, but when tried with fish they showed considerable promise. Continued experiments indicated that over 90% of the fish in the channel could be diverted with very low mortality to a location where they could be removed from the channel. The plan arrangement of the louvers or slats is shown in Figure 1.

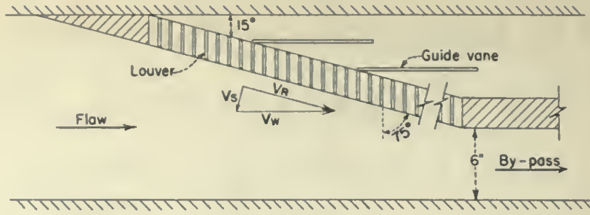
The arrows shown in the Figure illustrate the forces operating to divert the fish to a by-pass channel. The fish are carried tail first down the channel by the current, until they "feel" the disturbance to flow caused by the louvers. They then orient themselves at an approximate right angle to the louver structure in order to avoid the disturbance as shown by the arrow labeled "Vs."

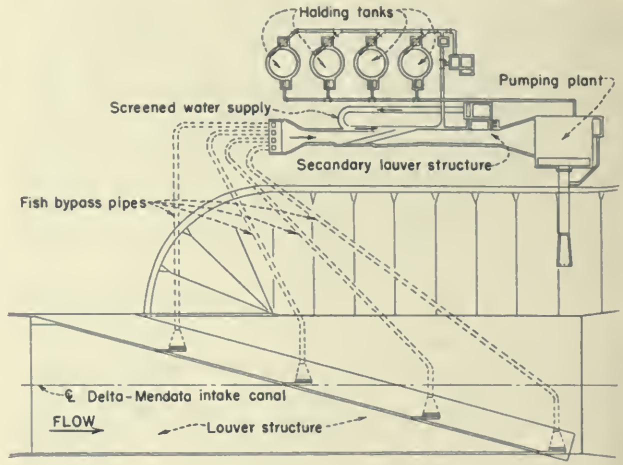
This velocity together with the velocity "Vw" in the channel produces the resulting velocity "Vr" moving the fish along the louver to the by-pass.

Numerous tests were made in the flume to fix the optimum angle of the louvers, the spacing of the slats and the approach velocities which would result in the most efficient diversion of the fish. To verify the results of the flume tests a five-foot-high louver structure was installed in one bay of the pilot structure. Numerous tests on this structure verified the flume test providing confidence that the full-size structure will operate successfully.

The layout of the permanent structure now under construction is illustrated in Figure 2. The fish enter the by-passes and are carried to a secondary louver structure. The water surface in this structure fluctuates with that in the main channel. The difference in water levels required to move water through the by-pass and secondary louvers is created by the pumping plant. A double secondary louver is employed to reduce the volume of water entering the holding tanks and to separate the fish and the peat-laden water. The two rows of louvers reduce fish loss to insignificancy. Separating fish from peat-laden waters is necessary to avoid suffocation by concentrating debris with fish in the holding tanks. The method of separating the fish from the debris-laden waters is unique. Screened water will be introduced at the side of the secondary louver channel near the by-pass in such a way that the screened water will flow alongside the peat-laden waters. Experiments have shown that there will be no mixing of the two waters. The fish will cross over into the screened water on entering the by-pass and will be conveyed to the holding tanks. The tanks will be concrete pits 20 feet in diameter and about 16 feet in depth with conical bottoms below which will be a bucket 6 feet in diameter and 5 feet deep. When the fish are to be transferred to a truck for hauling, water will be drained out of the large tank through the bucket until all the fish are concentrated in the bucket. The bucket will then be hoisted by a crane and carried to the loading area where the fish will be discharged into a refrigerated and aerated tank truck. The truck will then haul the young fish about 50 miles to waters destined for the ocean.

This structure will protect a fishery resource estimated to be worth $10,000,000 annually. It was originally estimated that about $4,000,000 would be required to build facilities which subsequent experience has shown would not have adequately salvaged fish. Not only will the structure described above save about $2,000,000 in initial construction cost but effect considerable savings in annual maintenance costs. Thus the Bureau of Reclamation in seeking a satisfactory solution to one of its many problems of getting water to the land has made a major contribution to the conservation of another valuable resource. This new method of diverting fish will have wide application in water resource development. ###





FISH COLLECTING FACILITIES

FIGURE 1, at top, shows plan arrangement of louvers or slats. FIGURE 2, below, shows layout of permanent structure.

"SETTLEMENT OPPORTUNITIES" Available

The 1956 edition of the pamphlet entitled "Settlement Opportunities on Reclamation Projects" is now available for public distribution.

The pamphlet is designed to give information to veterans and others who would homestead on irrigated public land; purchase private land acquired by the Government on reclamation projects and offered for sale; are interested in privately owned lands offered for sale by individual owners.

Copies of the pamphlet may be obtained by writing to your nearest Regional Director, or the Commissioner, Bureau of Reclamation, Washington 25, D. C. #

N. R. A. OFFICIALS FOR 1956—L. to R.: Harold H. Christy, Pueblo, Colo., Director and Second Vice President; LaSelle E. Coles, Prineville, Oreg., Director and First Cice President; Guy C. Jackson, Anahuac, Tex., Director and President; H. L. Buck, Billings, Mont., Director and Treasurer; and William E. Welsh, Washington, D. C., Secretary-Manager. *Photo courtesy of NRA.*

REPORT ON THE N. R. A. CONVENTION

We are very pleased to report that the National Reclamation Association had a very successful Convention in Lincoln, Nebraska, last October. Because of our quarterly publication schedule, it has not been possible to report to you heretofore.

The meeting was headed by outgoing President C. Petrus Peterson, and highlighted by the presentation of a check by Victor I. Corbell to Interior Secretary Douglas McKay for $159,500.10 representing the Salt River Project's final payment to the Government.

The newly elected N. R. A. officers are as follows: Harold H. Christy, Pueblo, Colorado, Director and Second Vice President; LaSelle E. Coles, Prineville, Oregon, Director and First Vice President; Guy C. Jackson, Anahuac, Texas, Director and President; H. L. Buck, Billings, Montana, Director and Treasurer; and William E. Welsh, Secretary-Manager.

Resolutions Outline Program

The resolutions which were prepared by the 17-man Resolutions Committee under the leadership of its new chairman, J. D. Mansfield, again this year outline a constructive and forward-looking program which every member of the Association can support with a great deal of pride.

The members of this Committee have the most difficult and strenuous task of any group who attend the annual NRA Convention. They usually start their sessions at least two days in advance of the general sessions and are confined to the Resolutions Committee meeting almost continuously until the resolutions are ready for reproduction on the evening of the second day of the Convention.

New resolutions this year include:

22. Joint Liability, which urges legislation to provide that persons should be relieved of any further liability with respect to payment of the organization's general obligation upon full payment of their assigned share of said obligation.

27. Weed Control, favoring appropriations for control of noxious weeds on public domain, and Federal assistance in control of noxious weeds on reclamation projects adjacent to public domain.

28. Basin-Wide Development and Financing endorses principle of basin-wide development and planning and use of basin-wide power and other revenues to aid irrigation.

29. Technical Assistance for New Settlers on Reclamation Projects' supports appropriation of funds specifically to enable Soil Conservation Service to render technical assistance to settlers on new projects.

31. Foreign Crop Competition urges consideration be given to protecting American market against foreign competitive marketing of farm products, and that foreign aid in improving crops be limited to their needs. #

EVERY YEAR MORE CROPLAND IS TAKEN OUT OF PRODUCTION BY URBAN AND HIGHWAY EXPANSION THAN IS BROUGHT INTO PRODUCTION BY RECLAMATION OF ARID LANDS.

CROP CHARGES ANSWERED

Continued from page 5

vested each year. The yield averaged slightly less than 2 bushels per harvested acre.

In the Columbia Basin project in 1954, wheat was grown on less than 12 percent of the harvested cropland with a yield of 43 bushels per acre. This is approximately double the per acre yield from dry land. However, the conversion of dryland farms to irrigated farms on the Columbia Basin project results *in a 50 percent reduction* in wheat production. Some may say this is an exceptional situation, so let's take a look at projects in Utah and in South Dakota.

If the dry farmed wheat land in counties adjacent to the Moon Lake project could be put under irrigation, the production of wheat would be reduced by about 53 percent. On the Angostura project in South Dakota wheat occupies only 2.5 percent of the harvested acres under irrigation as compared with 20.6 percent in the nearby dry farm area. By converting the project lands to irrigation, the production of wheat on these lands was reduced about 90 percent. It seems to me that this is ample refutation of any idea that construction of additional reclamation projects would add to the wheat surplus.

Rice production on Reclamation projects is less than one percent, and the production of soybeans amounts to less than one-tenth of one percent of our national production. Flaxseed under support which was produced on Reclamation projects amounts to less than one-fourth of one percent of the United States production.

Of the 13.7 million bales of cotton produced in 1954, almost 17 percent was under the support program. Production on Reclamation projects amounts to approximately 6.5 percent of the total production. The amount under support from Reclamation projects is only 1.27 percent of the United States production.

Here we have a situation in which cotton can be produced under irrigation in competition with any other area in the country. In a free market, the irrigated areas probably could continue to produce profitably and many of the producers in non-irrigated areas would be forced to other alternatives. To criticize this production is to put a premium on inefficiency.

Dry and edible bean production in 1954 totaled 17 million bushels. Approximately one-third of the total is produced on Reclamation projects. This is a western crop and a good crop, and we offer no apologies for producing it any more than anyone else should apologize for production of corn or wheat in the Midwest. However, only about 23.5 percent of the total 1954 bean production was price supported. This compared with 44 percent of wheat and almost 52 percent of rice production under the support program.

Thus, it appears rather evident that production of agricultural commodities on Federal Reclamation projects does not contribute significantly to the over-all farm surplus problem. In the light of forecast of future needs, it is also clearly evident that we should proceed with all speed to develop and bring into production all of the potentially irrigable lands of the West. ###

RECLAMATION STRUCTURES

Continued from page 8

period. The Department of Water and Power of the Los Angeles and the Southern California Edison Company operates the generating equipment.

The Federal investment in the Boulder Canyon project is to be repaid with interest at 3% by revenues from power and water storage, except for $25,000,000 allocated to flood control, which is to be repaid without interest.

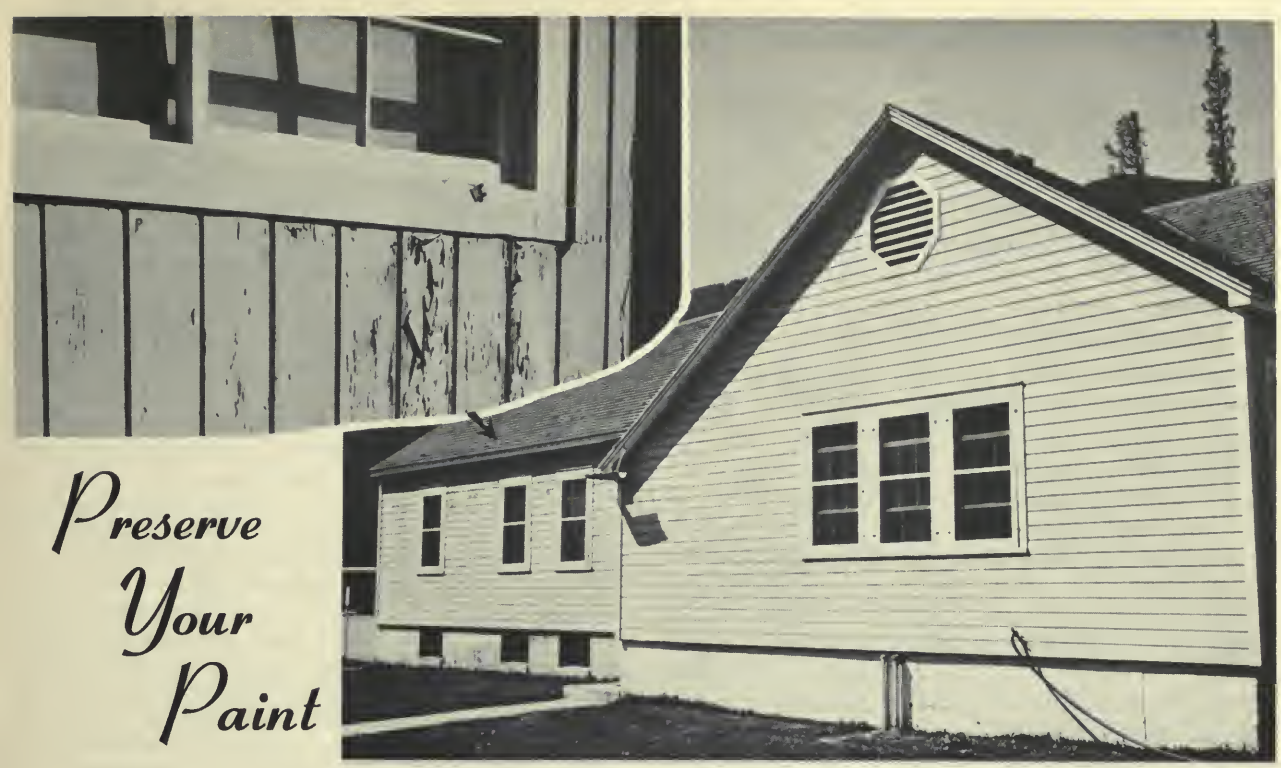
Water is the livelihood of the arid West where the region along the Colorado River receives no more than 5 inches of rain a year. Without irrigation crop production is out of the question. However, with irrigation made possible by the water stored in Lake Mead, behind Hoover Dam, hundreds of thousands of acres are in cultivation.

Because Hoover Dam regulates the flow of the Colorado River, the Los Angeles and San Diego metropolitan areas are assured of a stable supply of water for domestic and industrial purposes.

Completion of Hoover Dam in 1936 marked an epoch in river control and reclamation and bore out the statement "When better and bigger dams are built the Bureau of Reclamation will build them." ###

YOUR MAGAZINE

Are there particular types of articles which you would like to see in the Era that we have not printed to date? If so, please let us know, and we shall do our best to comply with your wishes.



Preserve Your Paint

By A. L. FOWLER, ENGINEER, DESIGN AND CONSTRUCTION DIVISION, DENVER, COLO.

Premature paint failures aren't always caused by faulty paint. Moisture condensation within exterior wall spaces often leads to early failure of the outside protective coating, no matter what the coating, the method of application, or the type of wood siding.

An article in the March 1953 issue of *Reclamation Era* described a coating for exterior plywood surfaces that has been found effective by Bureau engineers. Even this can fail, though, if moisture condensation is allowed to work from within.

The simplest measure to combat condensation in the dead air space between exterior and interior wall surfaces is to place small openings at the top and bottom of the outside surface. To prevent intrusion of rain and snow melt through these openings, special commercially available devices may be used. These can be driven into the siding from the outside, and provide openings large enough to permit air circulation without the danger of water entering through the openings.

The circulation thus provided allows air which enters from the outside and warm moist air penetrating from the inside to escape, thus minimizing condensation. In cold localities, the temperature difference between the outside and inside air can be so great that moisture vapor condenses in spite of circulation, and even the described remedy is not completely effective. In milder climates it is usually adequate.

But there are other ways to minimize moisture condensation. One, particularly adaptable to new construction, is to set up a water vapor barrier, such as asphalt-saturated paper, on the warm side of the dead air space. Other experiments have shown that reducing air leakage from the interior of the building is effective. This can be done by carefully calking cracks, especially those around electrical outlets, and by painting interior walls, particularly dry walls.

Bureau field forces are testing other ways of fighting this trouble maker called condensation. Results of these efforts as they develop will be made known to readers of future issues of the "Era." #

INTERNATIONAL ARID LANDS

Continued from page 12

Rio Grande for the past 10 years had been less than 50 percent of normal. He indicated that large quantities of water, estimated at 238,000 acre-feet per year, were being consumed in the bosque (swampy) areas of the valley by non-beneficial but heavy water-using plants. Mr. Thompson described that portion of the authorized Middle Rio Grande Project that is now under way to reduce this costly water loss by removal and control of this vegetation and improvement of the Rio Grande channel.

Salt Cedar Control and Channelization in the San Marcial Area of the Middle Rio Grande Project was outlined by Mr. E. W. Elliott, Chief, Operation and Maintenance and Drainage Division, Middle Rio Grande Project. He described the area as being some 35 miles long and 2 miles wide and stated that remedial work was started in 1952 by undertaking the construction of a low flow channel and floodway that is now completed. He estimated that water loss in this reach of the river amounted to 145,000 acre-feet annually and stated that he believed 40,000 acre-feet is a most conservative estimate of the water that will be conserved each year; records indicate that 138,000 acre-feet have been saved during the construction period of 2½ years. He outlined the difficulties encountered in controlling regrowth in the 5,000 acre floodway and stated that control measures such as aerial spraying with herbicides, have been successful to a varied degree. To make control more effective the aerial spraying is being augmented by disking, mowing and burning, and the application of herbicides by means of ground sprays. Further water conservation on the Rio Grande, within the limits of the Middle Rio Grande Conservancy District is being accomplished by an intensive brush and weed control program on the drains, canals and levees being rehabilitated by the Bureau of Reclamation and the Corps of Engineers.

Mr. John L. Gregg, Treasurer-Manager, Elephant Butte Irrigation District, Las Cruces, New Mexico, spoke on the topic "Condition of Irrigated Sections below Elephant Butte in New Mexico, Texas and Chihuahua." He stressed critical water conditions in the area caused by abnormally low runoff for the past ten years and measures that have been taken to alleviate the water shortage by well drilling and more careful use of existing supplies.

The annual discharge at San Marcial for the last 12-year period has averaged only 56 percent of the 60-year average. The most critical phase of the groundwater shortage has occurred during the last 5-year period. Four of these years produced flows of only about 30 percent of normal.

There are reported to be about 1,950 irrigation wells in the irrigated areas below Elephant Butte. The water table elevation has declined from 3 feet in the Mesilla Valley to about 19 feet in the Hudspeth Valley. Quality of groundwater for irrigation purposes has been subject to considerable variation. Mr. Gregg reported that groundwater in the northerly portion of the irrigated area is usually satisfactory but that quality declines toward the southerly portion of the irrigated area.

Tangible results from such a series of meetings cannot be expected at once, but summaries by several of the leaders indicated considerable progress. As was to be expected, there was a great deal of interest in new sources of water that might be furnished by such means as weather modification or artificial precipitation and demineralization of saline water. The suggestion was made that special studies of weather in arid regions are vital and that the problems of sedimentation and excessive use of water by non-beneficial plants should have more attention. Emphasis was given to the need for better conservation of present water supplies and that there is always the possibility of transporting water from humid to arid areas.

It appeared to be the consensus of the conferees that much of the benefit of such a meeting came from the opportunity personally to exchange ideas and to become aware of the problems in other countries. There was agreement that a worldwide agency is needed to assemble existing information and to disseminate it to all countries concerned. The first worldwide conference disbanded with the feeling that a start had been made toward unified effort to solve the problems of areas that have a major rainfall deficiency. ###

Utilization of Water From Tunnel Drain

Gateway tunnel was the first structure constructed on the Weber Basin project in Utah. The tunnel is about 3 miles long and is drilled through the Wasatch Mountains near the mouth of Weber Canyon. The drilling disrupted the natural flow of water from the springs in the immediate vicinity. The water taken from these springs appeared in the tunnel in well defined areas. By projecting theoretical lines upward along the dip and strike of the rocks, in these wet areas in the tunnel, they intercepted the surface very near the location of the springs. Surmising that the water appearing in the tunnel was coming from the aquifer or region that had previously supplied the springs, an 8-inch drain was installed beneath the invert of the concrete lining. The water that entered the tunnel and was lost during construction is now captured by the drain and utilized to replace the water lost from the springs. #

BANKS MADE KLAMATH COMPACT NEGOTIATOR by PRESIDENT EISENHOWER

Gettysburg, Pa., The White House announced, November 18, appointment of F. A. Banks to be a Federal representative for the Klamath River Compact negotiations. Banks, 71, has been a consulting engineer of the Columbia River District and U. S. Representative on the Columbia River Interstate Compact Commission. •

REGIONAL DIRECTOR J. P. "JACK" JONES DIES

On December 13, J. P. "Jack" Jones, Regional Director of Region 3, died at Boulder City, Nev. He had been suffering from a rare blood disease and had undergone treatment at the National Institutes of Health, Washington, D. C., and other medical centers.

Mr. Jones, a 28-year career engineer of the Bureau, was widely known in reclamation circles. He was a native of South Dakota, and after graduating from Colorado A. & M. College with a degree in civil engineering, went to work for the Bureau on the Minidoka project at Burley, Idaho.

He had been located at Boulder City since the establishment of the regional office in 1945, and had been regional engineer since that time until his appointment as regional director in March 1955. (For biographical sketch and photograph of Mr. Jones, see *The Reclamation Era* May 1955.)

Assistant Regional Director Wade H. Taylor has been named Acting Regional Director.

#

The Editor's Column

The following facts have been gleaned from the United States Department of Agriculture's statistical summary, dated November 18. We hope that you find them helpful.

High All-Crop Total

Crop production this year promises to equal the 1948 record high. Crop Reporting Board estimates, as of November 1, show that high yields per acre have more than offset total acreage reductions, with surprising outturns for a number of crops. Considerably more cotton and rice and silghtly more corn, sugar-beets, dry beans and sweetpotatoes are estimated than a month ago. Estimates are slightly lower for soybeans, sorghum grain, potatoes, tobacco, and peanuts.

Big Cotton Yields

The cotton crop is estimated at 14,843,000 bales. This compares with the 1954 crop of 13,696,000 bals and the 1944–53 average of 12,952,000 bales. New estimate is 7 percent above last month's forecast . . . little or no frost damage, and October weather was favorable for late cotton. Yield per acre, 431 pounds; compares with 279 pounds 10-year average.

Above Average Corn Crop

Corn production, at 3,183 million bushels, compares with last year's crop of 2,965 million bushels and the 10-year average of 3,080 million bushels. Yield, 39.4 bushels per acre, compares with 37.1 last year and the average of 36.4 bushels.

Other Crops—Nov. 1 Estimates

Dry beans—19,094,000 bags, 195,000 more than in 1954.

Soybeans—372 million bushels—8 percent above last year's previous record crop.

Sorghum grain—227 million bushels—11 percent above last year.

Rice—52 million bags—11 percent less than last year; up 4 percent from a month ago.

Peanuts—1,739 million pounds—70 percent more than last year.

Pecans—91.6 million pounds—1 percent more than last year; up 2 percent from a month ago.

Hay—109.9 million tons—record high, and 5 percent more than last year.

Potatoes—384 million bushels—8 percent above last year.

Apples—105 million bushels—down 4 percent from 1954; down 2 percent from a month ago.

Pears—30.1 million bushels—slightly less than last year and 3 percent below average.

Grapes—3,133,200 tons—22 percent more than last year.

Oranges—Early and Midseason crop—about 67.5 million boxes, 2 percent less than last year; Florida's Valencias, 39 million boxes, 7 percent above last year's crop.

Grapefruit (excluding California summer crop)—43.5 million boxes—7 percent above last year.

Better Pastures

Farm pastures November 1 were best for the date since 1951, but only about equal to the 1944–53 average.

LETTERS

Information Wanted

Dear Sirs:

I am going to take you at your word.

Give a report on Grand Coulee Dam, land to be irrigated, and what is accomplished in getting water on land. Give us some pictures of this new land.

I am an old subscriber.

Thanking you

(Sgd.) Ed Gialiam
667 S. Ardmore Ave.,
Los Angeles 4, Calif.

We are glad to have had you with us so long and hope to publish an article along the lines you suggest as space permits.—Ed.

Ability—Not Disability!

Dear Sirs:

Pardon the delay in acknowledging receipt of the November issue of *The Reclamation Era.* I have been out of town for the past month attending many meetings during the NEPH Week period and its subsequent followup meetings.

Your article, "Disabled Display Ability," is a fine piece of work and should stimulate other agencies to do likewise. In fact, I am greatly heartened by the increased awareness of the hire-the-handicapped program throughout the Federal service. It is pleasing to note that the Bureau of Reclamation is in agreement that it is the ability of a man that counts, not his disability.

With sincere appreciation.

Cordially,

(Sgd.) Mel Maas
Melvin J. Maas, *Chairman*

The President's Committee on Employment of the Physically Handicapped,

Washington 25, D. C.

We thank General Maas for his kind remarks and hope to continue to participate in this great program.—Ed.

BOOKS

WATER

The Yearbook of Agriculture 1955

There's a lot to be known about water.

We see and feel rain, snow, dew, fog. We use water for drinking and washing. We irrigate our lawns and fields. We talk about the weather, complain that it is too wet or too dry, and misquote Mark Twain about it. Most of us are conscious nearly all the time of the importance of water in our lives, but actually our knowledge of it is pretty skimpy.

We know the symbol of water but little about its properties, which can make us comfortable or uncomfortable, rich or poor, secure or insecure. We cannot live without water; we could live better if we knew more about it.

One purpose of this Yearbook is to supply as much information as we can about water in a practical, useful way for farmers and others who use water. But not only that.

Another aim is to emphasize that more information, more wisdom are needed. That need is mentioned again and again in the book; a whole chapter, in fact, is devoted to it. The realization of ignorance is the beginning of wisdom. The statement of a problem is the first step in its solution. It is a duty to discover facts in a true scientific, unbiased, unselfish spirit—a duty for us who prepared the book and, I submit, for those who read it.

The committee that planned the scope of the book set forth this aim at the start for the guidance of the men who wrote the chapters:

"Our primary aim is to explain the nature, behavior, and conservation of water in agriculture. We address ourselves to farm people and to all those interested in rural living. As our population increases, more demands are being made on our water resources; the effective use and conservation of water on farms will become increasingly important, and conflicts over water use will have to be resolved. Some of the broad problems are forecast, but our main emphasis is on the facts and basic principles that will help people in reaching the best decisions. Hydroelectric power, navigation, industrial use, pollution, and other aspects are touched on, but this book is concerned almost entirely with water in agriculture."

Superintendent of Documents,
Washington 25, D. C.

TOPSOIL & CIVILIZATION

by Tom Dale and Vernon Gill Carter

From his earliest beginnings, civilized man has depended upon the fertility of the soil for nurture and sustenance. His use or misuse of the land has influenced the course of work history more than any other single factor, for many great civilizations were built on good soil and fell after soil fertility had been depleted.

In this unique approach to history and conservation, world history is considered from the standpoint of man's relation to the sustaining land. The land on which he lived, rather than the races and tribes who occupied it, received the focus of attention.

Beginning with the Nile Valley, the condition of the land is traced from the earliest Egyptian civilization down to the present, for only by following the complete history of an area is it possible to determine what each race or group who lived there did to the land and how their treatment of it affected those who followed.

The Mediterranean areas are examined in detail, from Egypt and Mesopotamia to Greece and Italy, Sicily and Crete. A further look at Western Europe, the Americas, and Asia helps provide the global perspective needed for proper compension of the over-all soil conservation problem.

University of Oklahoma Press.

Major Recent Contract Awards

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DS-4423	Palisades, Idaho	Nov. 14	Two 37,500/50,000/62,500-kv-a. autotransformers for Goshen substation.	Legnano Electric Corp., New York, N. Y.	$202,762
DC-4453	Missouri River Basin, Nebr.	Oct. 24	Construction of earthwork and structures for Sargent canal laterals 6.0 through 20.0–0.9.	Rentlor Co., Inc., Grand Island, Nebr.	203,564
DC-4464	Palisades, Idaho	Nov. 10	Completion of Palisades powerplant and switchyards	E. V. Lane Corp. and Gunther & Shirley Co., Palo Alto, Calif.	679,063
		Nov. 14	One 230-kv. and three 115-kv. power circuit breakers for Granite Falls substation, schedules 1 and 2.	Brown Boveri Corp., New York, N. Y.	110,350
DC-4471	Missouri River Basin, Wyo.	Oct. 17	Construction of earthwork and structures for relocation and grade raises of Chicago, Burlington & Quincy RR. at Glendo Dam and reservoir.	Morrison-Knudsen Co., Inc., Boise, Idaho.	335,268
DC-4479	Eden, Wyo	Nov. 22	Construction of earthwork and structures for Eden lateral, sublaterals, drains, and wasteways.	Sharrock & Pursel, Casper, Wyo.	845,454
DC-4480	Missouri River Basin, Kans.	Oct. 10	Construction of Kirwin Main canal, Sta. 0+08.75 to 706+01.40, and Kirwin lateral system and drains.	Bushman Construction Co., St. Joseph, Mo.	959,182
DC-4481	Yuma Auxiliary, Ariz	Oct. 21	Construction of earthwork, concrete canal and lateral lining, pipelines, and structures for repairs, extensions, and improvements for Yuma Auxiliary project.	Marshall & Haas, Yuma, Ariz.	334,213
DC-4498	Columbia Basin, Wash	Nov. 15	Construction of earthwork, concrete lateral lining, and structures for west part of block 89 laterals, wasteways, and drains, west canal laterals.	Cherf Bros., Inc., and Sandkay Contractors, Inc., Ephrata, Wash.	427,984
DC-4501	Missouri River Basin, Nebr.-Kans.	Nov. 7	Construction of earthwork and structures for Courtland canal, Sta. 2003+90.2 to 2472+48, and wasteway, laterals, and drains.	Bushman Construction Co., St. Joseph, Mo.	926,070
DC-4502	Central Valley, Calif	Oct. 27	Construction of fish-collecting facilities for Delta-Mendota canal intake.	Fred J. Early, Jr., Inc., and John Delphia, San Francisco., Calif.	988,116

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DC-4503	Missouri River Basin, Wyo.-Mont.	Oct. 10	Completion of 46 miles of Lovell-Yellowtail 115-kv. transmission line.	Malcolm W. Larson Contracting Co., Denver, Colo.	$92,001
DC-4505	Colorado-Big Thompson, Colo.	Oct. 3	Rehabilitation and enlargement of Firestone section of South Platte supply canal.	Emerson S. Ellett, Inc., Denver, Colo.	381,429
DS-4512	Provo River, Utah	Nov. 21	Two 3,500-hp. vertical-shaft, hydraulic turbines for Deer Creek powerplant, schedule 1.	James Leffel & Co., Springfield, Ohio.	135,000
DS-4516	Missouri River Basin, Wyo.	Nov. 25	Four vertical-shaft, turbine-type pumping units for Lucerne pumping plant No. 1.	Fairbanks, Morse & Co., Kansas City, Mo.	51,100
DC-4517	Yakima, Wash	Nov. 10	Construction of earthwork and structures for Badger East and West laterals; and Highlands feeder canal and laterals.	Osberg Construction Co., Seattle, Wash.	464,435
DC-4541	Middle Rio Grande, N. Mex.	Nov. 23	Construction of earthwork and structures for Atrisco siphon and appurtenant features, utilizing monolithic concrete in siphon.	D. D. Skousen & Son, Albuquerque, N. Mex.	439,016
DC-4542	Provo River, Utah	Dec. 12	Construction of Deer Creek powerplant and switchyard	Jacobsen Construction Co., Salt Lake City, Utah.	190,557
DC-4543	Missouri River Basin, S. Dak.-Minn.	Dec. 16	Stringing conductors and overhead ground wires for 74.5 miles of Watertown-Granite Falls and 2.6 miles of Granite Falls-Northern States Power Co. 230-kv. transmission lines; and constructing footings and erecting steel towers for Granite Falls-Northern States Power Co. 230-kv. transmission line.	Lipsett, Inc., Yankton, S. Dak.	783,378
DC-4544	North Platte, Wyo	Dec. 1	Construction of Cottonwood siphon, Interstate canal	Riedsel-Lowe Construction Co., Cheyenne, Wyo.	109,547
DS-4549	Missouri River Basin, S. Dak.	Dec. 1	Three 20,000/26,667/33,333-kva. auto-transformers for Granite Falls substation.	American Elin Corp., New York, N. Y.	269,700
701C-390	Missouri River Basin, Nebr.-Kans.	Dec. 8	Construction of earthwork and structures for additional construction of Franklin, Franklin South Side, Naponee, Courtland, and Superior canals and laterals.	Glen A. Popejoy, Ulysses, Kans.	180,007

Construction and Materials for which Bids will be Requested Through March 1956[1]

Project	Description of work or material
Central Valley, Calif.	Earthwork, pipelines, and structures for extensions to Contra Costa Canal distribution system. Near Antioch.
Do	Installing pitot-tube test pits for calibration of flowmeters at 37 locations on the Delta-Mendota Canal and for 13 locations on Friant-Kern Canal.
Columbia Basin, Wash.	Earthwork and structures for a 15-foot 4-inch siphon 15,700 feet long, 2,500 feet of which will be steel pipe on piers and 13,200 feet of which will be monolithic concrete or precast concrete pipe. Wahluke Siphon, 6 miles south of Othello.
Do	Earthwork and structures for about 8.5 miles of 887- to 255-c. f. s.-capacity unlined canal with 37- to 18-foot bottom widths and 7.6 miles of 53-c. f. s.-capacity lateral with 8-foot bottom width, constructing about 1,000 feet of concrete-lined chute wasteway, and excavating about 1 mile of wasteway channel with 8-foot bottom width. Royal Branch Canal, lateral and wasteway, 10 miles north of Smyrna.
Do	Constructing about 43 miles of laterals, 7.8 miles of wasteways and drains and 0.25 mile of pipeline near Othello.
Do	Earthwork and structures for about 39 miles of 340- to 3-c. f. s.-capacity unlined laterals and wasteways with 18- to 2-foot bottom widths. Block 18 near Connell.
Do	Constructing about 1.25 miles of unlined lateral with 20-foot bottom width, an earth dike, and about 2 miles of 36- to 54-inch precast concrete pressure pipe pump discharge line. South of Quincy.
Do	Earthwork and structures for about 50 miles of unlined laterals varying in bottom width from 12 to 2 feet. Block 77, south of Quincy.
Do	Constructing the Evergreen Springs indoor-type pumping plant with 8 electrically driven horizontal pumping units of 253-c. f. s. total capacity and the 197-c. f. s.-capacity Frenchman Springs pumping plant. Near Quincy and Vantage respectively.
Deschutes, Oreg	Constructing a 600,000-cubic-yard earthfill dam 83 feet high and about 1,250 feet long at the crest. Haystack Dam, about 12 miles south of Madras.
Michaud Flats, Idaho.	Constructing the American Falls pumping plant including a concrete and structural steel building housing 4 electric motor-driven pumps of 126-c. f. s. total capacity, a switchyard adjacent to the building, and a 6,000-foot discharge pipe, surge tank, and discharge structure. Near American Falls.
Do	Drilling and casing 12 water-supply wells. Near American Falls.
Middle Rio Grande, N. Mex.	Excavating an earth settling basin about 2,000 feet long, 100 feet wide, and 15 feet deep; constructing steel manifold pipe, and installing corrugated metal pipe under railroad. Near San Acacia.
Do	Constructing 5 2-bedroom, frame-stucco residences with domestic wells, septic tanks and disposal fields, and L. P. gas systems. At the Pena Blanca, Cochiti, Angostura, Isleta, and San Acacia diversion dams in the general vicinity of Albuquerque.
Minidoka, Idaho	Earthwork and structures for laterals from group 7 wells, Unit B, North Side pumping division, near Minidoka.
MRBP, Montana	Constructing the 78-foot-high Helena Valley Dam and canal headworks. About 8 miles northeast of Helena.
MRBP, Montana.	Earthwork, structures, and gravel surfacing for 5 miles of abutment and valve-house access roads and placing additional gravel surfacing for 1.5 miles of existing access road for Tiber Dam. Near Chester.
Do	Constructing one 100-foot-long log boom for Tiber Dam. Near Chester.
MRBP, Nebraska.	Earthwork and structures for about 10 miles of canal with bottom width of 10 feet. Upper Meeker Canal, near Trenton.
Do	Constructing a 77-mile, 115-kv., wood-pole, H-frame transmission line. Fort Randall switchyard to Neligh.
MRBP, Nebraska-Kansas.	Clearing about 500 acres of timber, and removing and disposing of existing fences and improvements inside the reservoir. Lovewell Reservoir, near Superior.
MRBP, North Dakota.	Rehabilitating overhead ground wires on the 170-mile, 115-kv., wood-pole, H-frame transmission line between Williston and Garrison substations.
MRBP, Wyoming.	Earthwork and structures for about 20 miles of 90- to 10-c. f. s.-capacity main canal and 17 miles of 20- to 3-c. f. s.-capacity lateral. Hanover-Bluff Unit, near Worland.
Do	Constructing an 8-mile, 115-kv., wood-pole, H-frame transmission line from Alcova switchyard to Fremont switchyard.
Do	One 100-ton, single-trolley, motor-operated powerhouse crane. Glendo powerplant.
Do	Two 174-inch butterfly valves with 1 set of handling equipment. Estimated weight: 380,000 pounds. Glendo powerplant.
Do	Two oil-pressure, actuator-type, 107,600-foot-pound capacity governors for regulating speed of two 16,750-horsepower, vertical-shaft hydraulic turbines. Glendo powerplant.
Owyhee, Oreg	Constructing the Ontario-Nyssa pumping plant, which is to be an indoor-type plant with 4 electrically driven horizontal pumping units of 130-c. f. s. total capacity, upstream of and adjoining the existing Owyhee Ditch pumping plant at Nyssa.
Palo Verde Diversion, Ariz.-Calif.	Three 50- by 24.91-foot radial gates. Estimated weight: 340,000 pounds. Palo Verde Diversion Dam.
Parker-Davis, Ariz.-Calif.	Furnishing and constructing a multichannel microwave radio communication system, including masonry buildings and maintenance roads.
Santa Maria, Calif.	Constructing the 216-foot-high Vaquero Earth Dam and appurtenant structures, and about 4 miles of access road. About 12 miles northeast of Santa Maria.
Weber Basin, Utah.	Constructing the gated, reinforced-concrete Slaterville Diversion Dam, 2 canal headworks structures and 2 earthfill dikes. On Ogden River at Ogden.
Do	Earthwork and structures for 6.5 miles of precast concrete pipeline including turnouts, manholes, air valves and blowoffs. Davis Aqueduct, between Salt Lake City and Ogden.
Do	Constructing 13- c. f. s.-capacity East Bountiful and 14- c. f. s.- capacity South Davis pumping plants and appurtenant structures.
Yakima, Wash	One oil-pressure, actuator-type governor for regulating speed of an 18,000 horsepower, 158-foot head, 225-r. p. m. turbine for Roza powerplant.

[1] Subject to change.

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The Reclamation Era

May 1956

IN THIS ISSUE:

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The Reclamation Era

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In this issue . . .

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J. J. McCARTHY, Editor
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* * *

30 Years Ago in the Era

BETTER FARMING

BETTER BUSINESS

BETTER LIVING

BETTER farming simply means the application of modern science to the practice of agriculture. Better business is the no less necessary application of modern commercial methods to the business side of the farming industry. Better living is the building up, in rural communities, of a domestic and social life which will withstand the growing attractions of the modern city.

Sir HORACE PLUNKETT
In "The Rural Life Problem of the United States."

CUTTING O&M COSTS

THROUGH JOINT OPERATION

by AXEL PERSSON, Retired,
and JOSEPH COLLOPY
Irrigation Operations Branch
Region 6

Those charged with the operation and maintenance of irrigation systems are confronted by constantly rising costs. These rising costs are not confined to labor and supervision, but are also reflected in the necessary materials and equipment. In some instances these increased costs are met wholly or in part by increased assessments, but the general tendency is to attempt to have the water delivered without any increased cost to the water users. This procedure is apt to encourage deferred maintenance resulting eventually in higher costs and reduced revenue.

A program of preventive maintenance is always desirable, but is seldom properly followed when funds are low. Often a minimum amount of repair effort, if applied at the proper time, will save a drop or a major structure from more serious damage. The reinforcement of a canal bank that has been judged weak may prevent a major break with its resulting damage to the system and the area below.

Many irrigation projects have had their revenue sharply reduced by land going out of production through seepage. Canal lining or drainage at the proper time might have saved the loss. Reduced crop production can be brought about by unreliable or poor water distribution resulting indirectly in reduced income for maintenance purposes.

Operation and maintenance costs can be kept at a minimum by carefully selected or improved

equipment, efficient personnel, and skillful management. The dependable and versatile dragline has many uses on an irrigation project, but there are types of dredgers or side slopers that will clean several times the amount of canal under certain conditions. There are available types of equipment that will greatly reduce the cost of what is generally termed hand excavation. Properly designed power-spray equipment will reduce weed-control costs over hand or poorly designed units. Special trucks supplied with power equipment and selected tools are working to advantage on several projects. Various types of trailers have become a necessity toward reducing costs in many instances.

Large projects are in a better position to take advantage of the reduction in costs produced by specialized equipment as their workload will justify it. The same can be said of personnel with specialized or more thorough training. The management of small projects often sees the advantage that can be gained through properly selected equipment for various types of work, but is hampered by the funds available and see no solution.

Region 6 of the Bureau of Reclamation, Billings, Mont., has gathered information pertaining to actual expenditures over a number of years in the operation and maintenance of various size projects in the northwest with the results shown in the following table:

Comparative Costs for Large and Small Irrigation Districts

Irrigable Acreage	50,000 Class	20,000 Class	
Item	Per acre cost	Per acre cost	Difference in cost
1. General Costs (Includes administration, insurance, miscellaneous items	0.40	0.70	0.30
2. Replacement and maintenance (Major equipment)	.20	.30	.10
3. Water Supply Costs	.30	.35	.05
4. Water Distribution (Includes supervision, ditchriders, general maintenance, drainage, weed control, misc	1.30	1.65	.35
Total	2.20	3.00	.80

It is recognized in listing these figures that the annual amount expended for operation and maintenance is seldom the actual amount required to operate and maintain the system. The project is often being permitted to deteriorate, or is being built up from a run down condition.

The outright consolidation of projects, in order to produce a larger type of operation is seldom attempted. Some of the reasons are quite tangible and are often connected with the physical features such as pumps or reservoirs that affect the cost of operation. Other reasons based upon traditions, personalities, and the like, are not tangible but are often just as realistic.

It has been demonstrated that when small projects are properly situated they can enjoy the advantages possible for larger units. When a small project is adjacent to or near a large project the irrigation board of the smaller project can contract with the irrigation board of the larger project for the operation and maintenance of their project on what is generally considered a non-profit basis. Such an agreement often gives the small project many of the advantages of the larger project and at the same time reduces the unit overhead costs of the larger unit.

A method of carrying on a form of consolidated operation that has been successfully tried and deserves wider recognition is through a board of control. A board of control is a group composed of one or more members appointed by the various irrigation boards. In some instances the appointed members will select other members. The board of control members do not need to be members of an irrigation district, but must be qualified water users. It should be clearly understood that a board of control has no legal status and in no way replaces the individual irrigation

Continued on page 46

EFFICIENT TYPE dredger for canal lining.

Rapid Beef Gains

from tall wheatgrass pasture

by **BRYAN L. HARRIS**
Bureau of Reclamation
Carson City, Nevada
Region 4

Some 7 years ago the Nevada Nile Ranch at Lovelock, Nev., obtained a small amount of tall wheatgrass seed and planted a 4-acre plot. (See *Reclamation Era* article of August 1952.) They found it an excellent crop to grow on alkali-saline soils and have since expanded their plantings to several thousand acres. It is being used for pasturing beef cattle, for seed production, and for aiding in reclaiming alkali and saline soils.

Gus Momberg, Superintendent of the Nevada Nile Ranch, has tested the new grass under various soil conditions in the Lovelock area. While it naturally does better on the higher quality soils it was found to outyield any known grass in the area under irrigation and it does well on moderately salty soils.

Mr. Momberg has kept production records on their tall wheatgrass fields and has found that on poor land which would produce only a scant crop of barley of around 500 to 800 pounds per acre or about one-fourth of a normal yield, tall wheatgrass pasture produced 200 to 300 pounds of beef gain per acre. At current prices the gross values per acre of barley produced vs. beef gains on tall wheatgrass pasture could be figured at roughly $10 to $15 per acre for barley as compared to $30 to $45 per acre for beef gains on pastured tall wheatgrass. On the better land, production records show gains of 400 to 500 pounds of beef per acre.

Encouraged by the reports of the successful experiments being conducted by Mr. Momberg, a group of farm leaders from the Newlands project journeyed to Lovelock, Nev. (the heart of the Humboldt Reclamation project), to observe the pastures and to report the results to stockmen on the Newlands project. The conclusion of the group was that rapid beef gains can be obtained from tall wheatgrass pasture requiring a minimum of irrigation water. Charles Frey, Chairman of the Lahontan Soil Conservation District, which includes the Newlands project, summed up the results of the trip as follows: "Just to see these sleek, thrifty cattle on tall wheatgrass pasture means more to me than a world of statistics and proves to me that tall wheatgrass pasture is an excellent beef producer if it is managed right." George Miller, pasture chairman of the water users' organization, echoed Frey's sentiments by saying, "I wish every stockman in Churchill County could have been with us on this trip."

The enthusiasm of the Newlands project group is also shared by Jess Fowler of the Lahontan District Soil Conservation Service at Fallon, Nev. Under the direction of Fowler and assisted by other local agricultural leaders, by stockmen, and by the water users' organization, a 100-acre experimental plot was developed in the Carson Lake Area of the Newlands project. The 100-acre plot is part of an area of over 6,000 acres of similar land that could ultimately be developed if the experiment proves successful. The experimental plot, under its original condition, produced only a sparse growth of greasewood and iodine bush with little or no grazing returns. The 1954 season was the first year the tall wheatgrass plot was

pastured and beef gains of 134 pounds per acre were obtained. Fowler has high hopes of doubling this production in future years. During the first 6 months after seeding the basal leaves were dense and averaged 1½ feet in height while the seed stalks reached heights of over 3 feet.

In tests made at the Reno Experimental Farm of the University of Nevada Experiment Station with some 51 different varieties of grass, tall wheatgrass grew taller (as high as 61 inches at flowering time) and produced heavier (up to nearly five tons per acre on an air dry basis) than any of the other grasses in the experiment. The grass while making phenomenal growth and exceptional yields is very unpalatable if allowed to reach the flower or seed stalk stage. Also in mixed grass pastures livestock will select other grasses and leave the tall wheatgrass. For this reason tall wheatgrass is not recommended in mixed seedings; however, in solid stands, the grass is not only eaten readily, but has excellent nutritive value. The palatability can be increased by applying a good nitrogen fertilizer in August.

In getting new stands established, a number of failures have been noted because of improper preparation of seed bed. Although the grass, once established, is very hardy and thrives better in salty soils than most grasses, care should be taken in getting the seed germinated and the grass started. The land should be sufficiently leveled to assure adequate irrigation particularly in the early stages of germination, and growth.

Since tall wheatgrass makes rather slow growth in hot weather, it is recommended that summer pasturage be provided to supplement the tall wheatgrass. During the spring months of April, May, and June it can be pastured heavily and the regrowth beginning in September can be pastured right up to December 1.

Experience has taught that reclaiming alkali and saline soils can result in considerable expense particularly in the first few years of reclamation. An income during the reclaiming period is one of the chief advantages of tall wheatgrass over many other less salt tolerant grasses and other crops. The drainability of the soil and the process of leaching salts are aided materially by the massive and penetrating root system of the grass. Root systems reaching depths of 8 feet are not uncommon and are known to go as deep as 12 feet. Enormous quantities of humus material, estimated at from 3 to 5 tons on a dry basis, are added to the soil every year.

Common in the west are vast areas of mountain and desert grazing lands that are used by cattlemen in conjunction with irrigated lands; however, most grazing rights are taken up and the possibility of expanding beef operations is restricted by the limited available grazing facilities. One answer to the problem, while perhaps not the last word in pasture grasses, is the use of tall wheatgrass on unproductive alkali and saline lands, found on many irrigated projects of the west. These lands which would otherwise produce little or no return could reasonably produce beef cattle gains worth millions of dollars. # # #

Above: BEFORE DEVELOPMENT, Typical growth of greasewood and iodine bush in Carson Lake Area.

Below: AFTER PLANTING, cattle grazing on tall wheatgrass in Carson Lake experimental plot one year later.

CHANDLER POWER GOES ON THE LINE

CHANDLER POWERPLANT ON-LINE PROGRAM: L. to R.: W. L. Karrer, Construction Engineer, Kennewick, Wash.; L. N. McClellan, Assistant Commission and Chief Engineer, Denver, Colo.; Charles L. Powell, Master of Ceremonies, Kennewick, Wash.; and W. A. Dexheimer, Commissioner of Reclamation, Washington, D. C.

The two generating units of the Chandler Powerplant of the Kennewick Division, Yakima project in south-central Washington, were officially placed in service in February. Although originally planned for an on-site affair, the formal program marking completion of the plant was held in Benton City, several miles downstream on the Yakima River from the actual location of the Chandler plant.

In the weeks preceding the ceremony, the two 6,000-kilowatt generators in the plant had been tested and synchronized with the Bonneville Power Administration's system. Everything was in order for the program to go ahead at the powerplant. Then, as temperatures plummeted to 15° to 20° below zero, ice in the power canal blocked the trashracks of the Chandler plant just ahead of the penstocks. Generators were forced to shut down and the canal was dewatered. Because of these temporary adverse conditions, the formal program was moved to the Odd Fellows Hall in Benton City.

In talking to the more than 250 persons who attended the program, W. A. Dexheimer, Commissioner of Reclamation, said that the Chandler Powerplant was an integral part of the Kennewick irrigation development which would provide new homes for from 250 to 300 farm families in the next few years. Dexheimer also mentioned that, while small compared with the production of the multipurpose projects on the main stem of the Columbia River, hydroelectric production at the Chandler plant loomed very large in the Kennewick picture. Revenues from the plant will be used to assist with the payment of the construction costs of the Kennewick Division which are beyond the ability of the water users to repay.

Considerable tribute was paid by Charles Powell, M. C., during the program to the many pioneers who worked over the years for the development of the Kennewick area. "We are deeply grateful to those pioneers who laid the cornerstones for the program we are conducting", said Jerome Clarke, President of the Kennewick Irrigation District.

In addition to the Commissioner, Bureau of Reclamation personnel at the program included L. N. McClellan, Assistant Commissioner and Chief Engineer; O. W. Lindgren, Superintendent, Yakima Project; W. A. Karrer, Construction Engineer, Kennewick Division; H. T. Nelson, Regional Director, and D. S. Walter, Regional Engineer, both of Boise, Idaho.

Representing the Kennewick Irrigation District were Jerome Clarke, President; Walter Crayne, and Orvil Terrill, Board members. Charles L. Powell acted as master of ceremonies and read some of the numerous letters and telegrams from members of the congressional delegation, national, and state officials who were unable to attend the dedication. Jay Perry, Chairman, Kennewick Project Committee, introduced the numerous eminent people who were in attendance. Following the program, J. C. Pratt, Sr., General Chairman of the Program Committee, said, "We are pleased with the turnout for the dedication in spite of the winter weather. The interest of the people in the first major accomplishment of the project is most gratifying."

CHANDLER POWER and PUMPING PLANT, Kennewick Division, Yakima project.

Following the ceremony, a barbecued beef luncheon was served by the Chambers of Commerce of Benton City, Richland, and Kennewick, and the Prosser Commercial Club.

Construction on the Kennewick Division of the Yakima project is nearing completion and water will be available to almost 10,000 acres in the 1957 irrigation season. The project, when completed, will provide irrigation service to 14,500 acres of presently arid land and to 4,600 acres in the presently irrigated area. An additional 6,000 acres can be developed as part of the project in the future. The Chandler Powerplant will include two hydraulic turbine-driven pump units initially with provision for a third later. Each pump will have a capacity of 167 cubic feet per second and will lift the irrigation water across the Yakima River and 101.5 feet up into the main canal. The main canal for the Kennewick Division will be almost 42 miles in length and there will be over a hundred miles of laterals serving the project. # # #

IRRIGATION EXPERTS meet to discuss operating problems of irrigation districts. L. to R.: Floyd M. Roush, Chief of Irrigation Operations Division, U. S. Bureau of Reclamation, Region 7, Denver, Colorado; Floyd E. Dominy, Chief, Division of Irrigation, U. S. Bureau of Reclamation, Washington, D. C.; and R. J. McMullin, General Manager of the Salt River Valley Water Users Association, Phoenix, Arizona. *Photo courtesy of the Phoenix Gazette, Phoenix, Ariz.*

WHAT GOVERNMENT EXPERTS SAY ABOUT SURPLUSES:

- Farm surplus production will end in less time than it takes to put even a middle-sized Reclamation project into operation.
- Starting about 5 years from now, our big problem will not be too much farm production but TOO LITTLE.
- Recent abnormally good crop years cannot continue indefinitely; ONE YEAR of real drought, such as we had in the 1930's, would wipe out all our surpluses.

These are the considered predictions of top officials of the U. S. Department of Agriculture. They reveal the urgent need to build Reclamation developments now to prepare for the Nation's future growth.

(*Reprinted from The February Issue of Reclamation News, official publication of The National Reclamation Association*)

BLUEBIRD II BREAKS WORLD'S RECORD ON LAKE MEAD

By CHARLES A. RICHEY, Superintendent, Lake Mead National Recreation Area, National Park Service, Boulder City, Nev.

Zooming across the surface of Lake Mead at speeds greater than man had previous attained on water, England's Donald Campbell set a new World's Unrestricted Water Speed Record at 216.25 miles per hour last November 16, 1955.

Eyes and interest of the world were focused on the courageous young Englishman and his jet-propelled hydroplane, the *Bluebird II*, as he made his attempt for a record run. He already was the record holder, having gained it the hard way a few months before when he piloted the *Bluebird* to the shattering speed of 202.32 m. p. h. on Lake Ullswater in England on July 23. Now he was out to better his own mark.

Lake Mead, a reservoir of water, backed up behind Hoover Dam, had been selected as the site for this new attempt. In early October, the boat was flown from Britain and underwent preliminary tests and trials.

On October 16, the stage was set for the *Bluebird*

BLUEBIRD II setting new world's water speed record at top. ***Photo courtesy Las Vegas News Bureau.***

PROUD SPEEDSTER Donald Campbell and his blue jet-propelled Bluebird II at right. ***All photos in this article, except top one on this page, courtesy National Park Service.***

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HAWAII KAI, another powerful hydroplane.

to speed across Lake Mead in its initial record-breaking try. Television cameras were in place to bring the scene to the screens of thousands of viewers via the "Wide, Wide World" program. Cameramen and reports from the major national wire, newsreel, television, and press services were on hand to record the events.

For such a temperamental speedster as the *Bluebird*, the water conditions were not ideal for a record run. The wake from countless spectator boats had set up a series of swells which made such an attempt impossible. But Campbell ran the boat through its paces at about 150 m. p. h. for the benefit of the many viewers. Later as it was being taken to dock, the *Bluebird* sank near shore; too much water had slopped into the open jet tail pipe.

The *Bluebird* was retrieved and the undaunted Englishman began the tremendous task of cleaning up and repairing the boat for a new assault.

For this new run, a measured kilometer course was laid out off shore from Boulder Beach. With increased enthusiasm but with the lack of fanfare which accompanied his initial trials, Donald Campbell sped his jet-beauty on the first run at 239.5 m. p. h. With wind conditions disturbing the water and poor lighting, he was able to force the boat to 193 m. p. h. on the return run. But his average of 216.25 m. p. h. placed Campbell in a class by himself, the world's fastest man on water!

This event placed world wide attention on the Lake Mead National Recreation Area which is administered by the National Park Service under cooperatively intradepartmental agreements with the Bureau of Reclamation.

Here speed boating is rapidly becoming a very important recreational sport. During 1956, three racing events are definitely scheduled and plans for others are being formulated. Stock outboards will race on June 10 and divisional stock outboard events will be held on August 11 and 12.

Highlight of the racing season is expected on October 13 and 14 when the inboard speedboats and the powerful unlimited class boats will vie for top honors.

Considerable enthusiasm has already been generated to make the Lake Mead National Recreation Area into one of the top boat racing centers in the entire country.

Last July, Mexican Road Race Champion Ray Crawford brought his untried but powerful hydroplane the *Zephyr Fury* to Lake Mead with intentions of speeding the boat to a new record. Campbell's record was made in England, however, before sufficient modifications of the *Zephyr Fury* could be made for Crawford's attempt.

Band Leader and Speedster Guy Lombardo, and speed boat designer Ted Jones are among those especially enthusiastic over the racing potentialities on Lake Mead.

Henry J. Kaiser, Jr.'s Gold Cup class hydroplane, the *Hawaii Kai*, raced over the Lake Mead course in November at unofficial speeds greater than 180 m. p.h. This surpasses the official world's record water speed for propeller craft which stands at 178.497 m. p. h. set by Stanley Sayres in

WIDE, WIDE WORLD Television Program of the Bluebirds' October 16 run.

BLUEBIRD II streaking into dock after dash on Lake Mead. Fortification Hill "trademark" of the region towers across the Lake.

Slo-Mo-Shun on July 17, 1952, at Seattle, Wash.

The *Hawaii Kai* may make its official attempt to break Sayres' record on Lake Mead in the near future.

Speed boat racing, although spectacular, is but one of the many recreational activities which 2,675,371 visitors enjoyed within the Lake Mead National Recreation Area during 1955. Boating, fishing, water skiing, swimming, skin-diving, camping, hiking, exploring, picnicking, photograph-taking, hunting, sightseeing, and motor-touring are other pastimes for which the National Park Service has developed and provided facilities around the shores of Lake Mead and Lake Mohave.

Spectacularly beautiful and climatically ideal, the Lake Mead National Recreation Area is rapidly becoming one of the largest and most heavily used all-year recreational centers in our Nation.

# # #

WADE H. TAYLOR
NAMED
DIRECTOR IN REGION 3

On March 14, Secretary of the Interior Douglas McKay announced the appointment of Wade H. Taylor as Regional Director, Region 3, to succeed the late J. P. "Jack" Jones. Mr. Taylor's headquarters will be Boulder City, Nev.

He was born in Ambia, Ind., in 1908 and attended Purdue University and the University of Colorado, receiving his Bachelor of Science and Master of Science degrees in electrical engineering from the latter. While at the University of Colorado, he was a member of the Tau Beta Pi, Sigma Tau, and Eta Kappa Nu, national honorary engineering fraternities and Sigma Pi Sigma, honorary physics fraternity.

After receiving his Master's degree, Mr. Taylor joined the engineering staff of W. A. Bechtel Co., at Denver and worked on the Fraser River—Moffat Tunnel—Ralston Creek diversion project. His first appointment with Reclamation came late in 1935 when he accepted a position in 1935 as Junior Engineer on the Chief Engineer's staff in Denver. In 1938, he transferred to the Electrical and Mechanical Division of the Chief Engineer's Office and in 1944 to the Branch of Power Utilization in Denver. Early in 1945 he transferred to the newly formed Region 3 office at Boulder City as Assistant Regional Power Manager. Late in 1951 he became Regional Power Manager, and the following year was named Assistant Regional Director, the position he held at the time of his present appointment.

While in Denver, Mr. Taylor was a member of the Colorado Engineering Council and chairman of the Denver Section of the American Institute of Electrical Engineers. In 1951, he was awarded the rank of Fellow in the A. I. E. E. that organization's highest grade. This award was based on his outstanding administrative and technical work in connection with hydroelectric installations.

During his 21 years with the Bureau of Reclamation he became one of its foremost hydroelectric authorities and top administrators.

Mr. V. E. Larson, another veteran Reclamation employee, who has held the position of Regional Planning Engineer, will succeed Taylor as Assistant Regional Director. #

IS ROADSIDE MARKETING PROFITABLE?

by ARLIE S. CAMPBELL
Secretary of the Weber Box Elder Conservation District

CONVENIENCE for the CUSTOMER.

The Ogden River project has given impetus to an industry which already had small beginnings before the project began to operate in 1937. This is the roadside marketing of fruits and vegetables by the farmers direct to the consumer.

The industry is chiefly concentrated on Highway 91 and extends from Brigham City south to the Weber County line, a distance of about 12 miles.

For many years the Brigham City area had enjoyed an enviable reputation as the producer of luscious peaches and other fruits adapted to our Utah climate. However with the coming of additional irrigation water from the Ogden-Brigham Canal fruit growing was greatly expanded and the roadside stands mushroomed along the highway. In addition to an abundance of irrigation water, there have been two other contributing factors which have stimulated the selling of produce through roadside channels.

Highway 91 is the only arterial highway leading from Utah into Idaho and the Northwest. Also the great increase in tourist traffic since the war means that thousands of tourists now pass the displays of fruit and vegetables daily, and a large majority of the produce sold from the roadside stands is bought by the tourists. Other purchasers include housewives who drive out from Ogden to get their canning peaches, tomatoes or other items direct from the farmer.

Some of the stands are small, unpretentious structures, the produce of home carpentry, while others are comparatively large elaborate buildings which represent substantial investments. But whether large or small the business has grown so rapidly that it is estimated that over $300,000 worth of produce is marketed annually within this small segment of Highway 91.

To meet the demands of roadside shoppers the farmers have attempted to stretch the marketing season by growing as wide a variety of products as the soils and climate will permit.

Strawberries and raspberries are available in the latter part of May or the first of June. These are followed in succession by cherries (both sweet and sour), apricots, plums, early peaches, early potatoes and sweet corn. The business reaches its greatest volume about September 1st when Elberta peaches come on the market. Apples, potatoes, tomatoes, cantaloups, melons and squash are displayed and sold until the chill of autumn draws the curtain on the year's activities. #

1956 WATER SUPPLY OUTLOOK

by HOMER J. STOCKWELL

Snow Survey Supervisor, Soil Conservation Service, Fort Collins, Colorado

and

NORMAN S. HALL

Snow Survey Leader, Soil Conservation Service, Reno, Nev.

KING WINTER REIGNS over Anderson Ranch Dam, a key feature of the Boise Project in Idaho. *Photo by Robert Gregory, Region 1.*

Streamflow from snow melt will be much above average in the northern half of Western United States during 1956. The water supply outlook drops rapidly in the south where summer flow of the Rio Grande in New Mexico, and Colorado River tributaries in Arizona will be only one-quarter of normal.

The pattern of 1956 water supply follows that of 1955 in general outline, except that streamflow in most of the Pacific Northwest will be extremely abundant. Supplies will be reasonably adequate in northern parts of Colorado, Utah, Nevada, and most of the Central Valley of California. Critical shortages will again occur in 1 or 2 localized areas in Utah, along the Rio Grande, in the Salt River Valley in Arizona and in southern California. These latter three areas will depend largely on stored water, underground pumping and trans-river diversions.

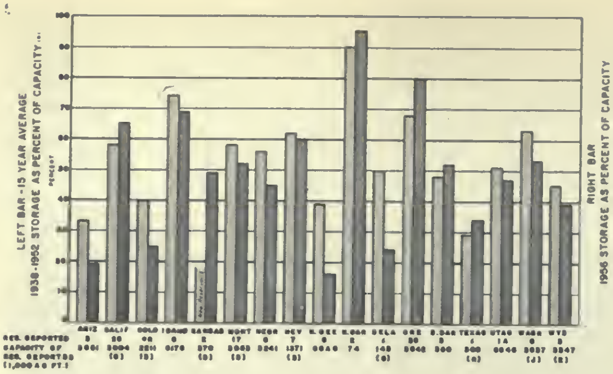
This April 1 West-wide report is based on snow surveys, reservoir storage, soil moisture in mountain and irrigated valley areas, and other factors affecting 1956 supply. Runoff in prospect for irrigation, power generation, and municipal and industrial uses will be more than adequate in the Northwest. April–September volume flow of the Columbia River, as measured at The Dalles, is expected to equal that of any recent year, including the unforgettable flow in 1948. Mild to severe shortages will be experienced south of a line that stretches from central Colorado, westerly through Great Salt Lake to the southern end of California's Central Valley.

This summary of supply conditions is compiled for RECLAMATION ERA by Soil Conservation Service of the United States Department of Agriculture. This analysis of April 1 snow surveys, reservoir storage and other factors affecting this year's water supply is again presented in the *Reclamation Era* through the courtesy of the authors, and *Mr. R. A. Work*, Head Water Supply Forecasting Section. It is based on snow surveys made by that agency and many cooperators on about 1,250 snow courses in western United States and in the Province of British Columbia in Canada.[1] With this report USDA and Soil Conservation Service complete 21 years of snow surveying and water supply forecasting in the West.

The drought condition in the Southwest is not quite as severe and extreme as it was in 1955. However, the 1955–56 snowfall pattern over mountain areas of the West is an extension of one existing for five years. Columbia River Basin has had consistently higher snow packs and runoff than drought and water-short areas in the Southwest. This year's pattern is accentuated by prospect of extremely high flow in many tributaries of the Columbia and in its main stem.

The Southwest's low streamflow pattern has continued so long that the long-term water supply outlook for much of New Mexico, Arizona, and parts of Utah and Nevada is poor. Reservoir storage has declined to a fraction of the normal levels of a few years ago. Underground supplies are being depleted. In extreme cases, crop acre-

[1] The Soil Conservation Service coordinates snow surveys conducted by its staff and many cooperators, including the Bureau of Reclamation, Forest Service, Geological Survey. other Federal Bureaus, various departments of the several States, irrigation districts, power companies, and others. The California State Division of Water Resources, which conducts snow surveys in that State. contributed the California figures appearing in this article. The Water Rights Branch, British Columbia Department of Lands and Forests has charge of the snow surveys in that province and likewise contributed the information here for British Columbia.



RESERVOIR STORAGE AS OF APRIL 1, 1956

(A) Most State averages for reported reservoirs are for a 15-year period (1938–52) but in a few cases reservoirs with shorter records have been included. (B) Does not include Shasta, Millerton, Isabella, Folsom, or Pine Flat Reservoirs (combined capacity 7,601,800 acre-feet); April 1, 1956, combined storage 5,127,630 acre-feet. (C) Does not include John Martin Reservoir on the Arkansas River (capacity 655,000 acre-feet) April 1, 1956, storage 44,000 acre-feet; or Granby, Horsetooth, and Carter Lake of the Colorado-Big Thompson project (combined usable capacity 756,000 acre-feet) April 1, 1956, storage 153,400 acre-feet. (D) Cedar Bluffs and Kirwin Reservoirs. (E) Does not include Fort Peck Reservoir (capacity 19,000,000 acre-feet); April 1, 1956, storage 4,990,000 acre-feet; or Flathead Lake (capacity 1,791,000 acre-feet); April 1, 1956, storage 710,000 acre-feet; or Hungry Horse Reservoir (capacity 3,500,000 acre-feet); April 1, 1956, storage 2,084,000 acre-feet. (F) Does not include Lake Mead (capacity 27,217,000 acre-feet); April 1, 1956, storage 10,720,000 acre-feet. (G) W. C. Austin Reservoir (new in 1945). (H) Red Bluffs Reservoir on Pecos River. (J) Irrigation reservoirs only. Does not include Roosevelt Lake (capacity 5,072,000 acre-feet); April 1, 1956, storage 4,047,000 acre-feet or Grand Coulee Equalizer (capacity 761,800 acre-feet); April 1, 1956, storage 452,000 acre-feet. (K) Does not include Boysen Dam (capacity 758,000 acre-feet); April 1, 1956, storage 3,000 acre-feet.

age is being reduced and municipal supplies have been restricted. Adding to the problem is an ever-increasing demand on the available water supplies. Over most of the Southwest a series of heavy snow years is much to be desired.

Storage in irrigation reservoirs is generally about normal in the Northwest, but below normal in most of the other States of the West. This is the result of below average streamflow in 1955 and previous years. Deficiency in stored water is most critical in Arizona and New Mexico.

SUMMARY OF WATER CONDITIONS

After relatively heavy early winter snow, the water supply prospects in the Rio Grande in Colorado and New Mexico have declined to much less than normal and are only slightly improved over 1955. Increasing use of underground water must be planned; crop acreage will again be curtailed. Prospective runoff into Salt River Valley reservoirs, along with other streams in Arizona, ranges from 10 to 40 percent of normal. The outlook is similar to a year ago. Nearly all stored water is expected to be used in 1956. Extensive pumping must be continued.

The Central Valley of California will have above normal streamflow in most areas. Local shortages will occur on southern sections of the San Joaquin Valley irrigated areas not served by diversions from the north. Natural runoff in the South Coastal region will be light. To meet requirements, heavy demands will be made on the Colorado river.

Adequate supplies will be available to meet demands along upper Colorado River and its tributaries in Colorado, Wyoming, New Mexico and northern Utah. In southern Utah some shortages will occur on the Colorado River and Great Basin, with an extreme shortage expected on the Sevier River. Northern Utah will have near-normal supplies. Irrigation supplies are excellent on the eastern slope of the Sierras in Nevada and good along the Humboldt River. Reservoir storage is near normal.

The outlook for the Platte River in Colorado, Wyoming, and Nebraska has improved over the past 2 years. Total supply is near average and will be adequate to meet requirements in all but those areas with marginal irrigation rights and heaviest demands. The flow of the Missouri River tributaries in northern Wyoming and western Montana will be about 25 percent above normal, and 50 to 60 percent above that for the 1955 season.

Snow pack on the Columbia River Basin is extremely high. Many snow courses have record-high measurements as of April 1, 1956. Water supplies will be abundant along all major streams serving irrigated areas in all of Idaho, Oregon, Washington, and northwestern Montana. Carryover storage in reservoirs is close to normal. Many reservoirs are being lowered in anticipation of extremely heavy inflows to come. Mountain soils over the basin are generally wet.

Forecasts for major streams of the West for the April–September 1956 period include the Columbia River at The Dalles at 131,000,000 acre-feet or 135 percent of normal; Missouri River at Toston at 2,850,000 acre-feet or 126 percent of normal; Colorado River at Grand Canyon at 10,000,000 acre-feet or 99 percent of normal, and the Rio Grande at Otowi Bridge at 375,000 acre-feet or 45 percent of normal. These forecasts indicate the general water supply outlook for the major streams of the West.

In the following paragraphs the water supply outlook is briefly reviewed by States. A chart showing the status of reservoir storage in each State and a map indicating the approximate runoff forecast summarize the 1956 outlook for each area of the West.

ARIZONA.—Arizona's outlook is the poorest since 1938. Runoff forecasts are for flows that continue the pattern of the last several years, a range of 10 to 40 percent of the 1938–52 average. With reservoir storage at only about 20 percent of capacity and 60 percent of normal for this date, it is apparent that a season of very deficient water supplies is ahead. Prospective supplies appear adequate to carry the Salt River Valley through summer irrigation, with little or no carryover storage to remain at the end of the season. San Carlos project faces a continuation of the very deficient supply it has had for several years. Pumpage can supply only part of the needed water. Almost all other Arizona areas are in substantially the same situation. Normal water supply is anticipated only

Continued on page 51

SCENIC GREEN MOUNTAIN DAM, one of the key features of the Colorado-Big Thompson Project, is the mecca of thousands of tourists. *Photo by N. T. Novitt, Region 7.*

PREVENTING PARCHED ACRES

by ROBERT E. STRUTHERS
Agricultural Economist
Denver, Colorado, Region 7

FOR THE THIRD SUCCESSIVE YEAR, Colorado-Big Thompson project supplemental irrigation water in 1955 spelled the difference between success and failure of crops in many parts of northeastern Colorado.

Drought began in 1953, the same year when project construction, started in 1937, reached the stage of permitting delivery of large quantities of Western Slope water diverted through the Alva B. Adams Tunnel.

By 1954, the project was ready with water to combat what had become the most severe drought Colorado farmers ever experienced. The 301,000 acre-feet of project water used in that year meant an estimated $22 million boost in crop value.

The drought cycle continued into the 1955 season—again calling for emergency water delivery from the project storage system. The 240,000 acre-feet of transmountain water furnished in 1955 represented one-third of the total surface irrigation water in the area served by the Northern Colorado Water Conservancy District. And it likewise accounted for one-third of $51,210,000 in crops, or $17 million.

Normal inflow to the district averages about 900,000 acre-feet annually. By the reuse of return flows this initial supply is multiplied to the extent that actual measured diversions throughout the district total 2,200,000 acre-feet. Another half-million acre-feet are supplied by well irrigation, all of which arises out of the initial inflow.

The average supplement to be provided by the Colorado-Big Thompson project is estimated at 257,000 acre-feet. Approximately the same rate of recurrence is expected of this water, and the beneficial effects will thus be felt throughout the district as well as in the areas of initial application.

Upper Left: HORSETOOTH FEEDER CANAL. General view looking downstream along canal. *Photo by A. E. Thompson, Region 7.*

At right: BENEFITS from the Colorado-Big Thompson Project are NATIONWIDE. See how industry, manufacturing, transportation, etc., get a lift from Western Reclamation.

The project is expected to furnish about 22 percent of the district's annual supply. In 1954, however, the project water was 45 percent of the supply and in 1955 it was 34 percent.

Availability was even more important, in 1955, than quantity. Throughout the unusually dry spring months project water was heavily used. For the season, the "C–BT" supplied 58 percent of the stored water used.

The same drought conditions that multiplied the uses at the same time prevented replenishment of storage. At the end of the year, the 804,000 acre-feet of project storage capacity contained only 239,000 acre-feet of water. As the spring of 1956 approached, however, a heavy snow pack in the mountains held forth hope that total storage may increase even while full demands are met for supplemental irrigation water.

The water content of snow on the Colorado River drainage above Granby Reservoir, the project's main storage, was 160 percent of the 20-year average at the end of January. Should the rains be scant and the suns hot again in the summer of 1956, there still is assurance that near adequate supplies will be available for the district and the seven towns served with municipal water.

Crop production within the district increased about 8 percent in 1955 over the previous year, offsetting a 6 percent price decline. Farmers were not entirely spared the expenses and frustrations of drought, seeing sugar beet and corn plantings lost and having to replant to beans and sorghums.

The Big Thompson farmers commiserated with their fellows elsewhere in Colorado who had no means of supplementing their irrigation, or had no irrigation at all. Winter and spring moisture deficiencies destroyed the plantings on thousands of acres. The production of wheat, the major dry-land crop, was only 40 percent of the past 10-year average.

Abandonment of croplands over the State amounted to 43 percent of the cropped acreage. These failures, coming on the heels of 1954 when 39 percent of the crop acreage was abandoned, had an extremely depressing effect on the Colorado farmers' economic status. Business was down in drought-stricken communities and mortgage debts increased.

Business traditionally prospers or declines in western farming communities in direct proportion to moisture conditions. It follows that local merchants are among the most enthusiastic supporters of the Colorado-Big Thompson project.

Retail sales tax collections are an indicator of general business conditions and volume of spending. In the northeastern and southeastern irrigated valleys of Colorado, widely divergent trends in retail sales tax collections are evident, although both areas have been affected similarly by drought.

In the northeast, where supplemental water has been available, a progressive growth trend has been established. In the southeast, where drought-

Available Water Supply in Northern Colorado Water Conservancy District

[Acre-feet]

	Normal year	1953	1954	1955
Local supply:				
Inflow to district	900,000	671,800	314,700	472,300
Local storage	------------	(+)36,700	(+)59,600	(−)10,700
Total	900,000	708,500	374,300	461,600
Project water	257,000	177,500	301,000	240,000
Combined gravity supply	1,157,000	886,000	675,300	701,600
Growing season precipitation	540,000	355,000	234,000	483,000
Total available water	1,697,000	1,241,000	909,300	1,184,600

induced water shortages remain uncorrected, retail sales have declined with serious effects on the valley towns.

Such indirect effects are well known and accepted in irrigated communities. The Northern Colorado Water Conservancy District, contracting agency with the Government for construction of the Colorado-Big Thompson project, is organized under a pioneering law passed in 1937; under the law, the general population of 160,000 is helping to support the project through ad valorem mill levies. This form of support recognizes that the project means added stability and new wealth, not only for farmers but also for townsmen. Many similar conservancy districts have now been formed throughout the West.

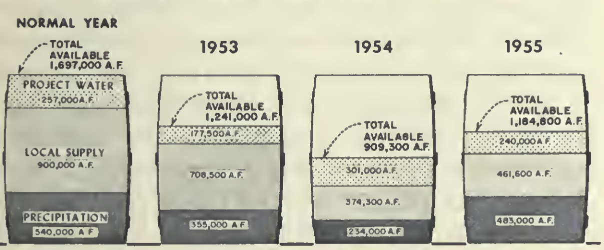
The project provides an important service to Western Slope irrigators. Western Slope project reservoirs include storage sufficient to replace any project-induced shortages among irrigators on that side of the Continental Divide. In addition, 95,000 acre-feet of storage capacity was provided on the west side for future irrigation expansion.

In 1955, Western Slope irrigators drew 39,000 acre-feet of water from this storage to offset shortages in their own supplies. This was water that otherwise would have been lost in the surplus spring flows, and it was provided without cost to the Western Slope irrigators.

These farmers could join the farmers of northeastern Colorado in a hymn of praise. Both groups are able to tell anyone of the wisdom and foresight of the individuals, private and public, who brought the Colorado-Big Thompson project into existence. # # #

COMPONENTS OF WATER SUPPLY

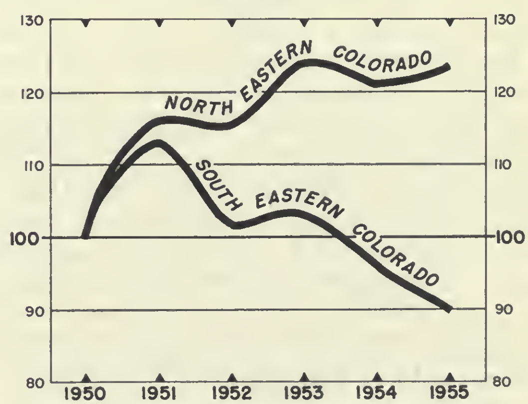
Northern Colorado Water Conservancy District



TRENDS IN SALES TAX COLLECTIONS

IRRIGATED COUNTIES - EASTERN COLORADO

1950 equals 100



Above: THE TAX PICTURE.

At left: FOR PURPOSE of COMPARISON.

Reclamation's HALL OF FAME

NOMINATION NO. 21

John C. Page

by **D. L. GOODMAN, Engineer**
Commissioner's Office
Denver, Colo.

On the retirement of John Chatfield Page from the Bureau of Reclamation in 1947, former Secretary of the Interior Ickes wrote: "To the outstanding reclamationist who has had so many dam troubles most of his life that the West wasn't big enough to contain them, I give an Irishman's toast—may the skin of a gooseberry be more than ample to contain all of your future difficulties."

Yet the future for John Page was not to be without difficulty. He was to remain a semi-invalid or invalid until his death in 1955, of an illness, which, according to medical opinion, was caused by heavy overwork during his tenure as Commissioner of the Bureau of Reclamation from 1937 to 1943. He was nationally known in the field of engineering, having served in every known engineering capacity with the Bureau since 1909.

Under his leadership as Commissioner, the Bureau was distinguished by one of its most brilliant eras of accomplishment with the construction of many world-renowned dams, including Grand Coulee, Shasta, Friant, Parker, Imperial, Bartlett, Seminoe, Alcova, and Marshall Ford Dams.

In 1930 the Bureau began marshalling its engineering forces for its attack on one of the world's largest and most difficult construction undertakings—the building of Hoover Dam on the Colorado River. Topflight talent was sought among the Bureau's engineers to administer the construction of the 726-foot high dam, unprecedented in engineering experience. With his record as the able and efficient project superintendent of the Grand Valley project, Mr. Page was chosen as office engineer for the building of the dam.

At the Boulder Canyon project headquarters in Boulder City, Nev., Mr. Page's stature as an engineering administrator grew during the hectic years that followed the start of construction of the dam in 1931. Aided by a small office staff he shouldered the herculean task of supervising the office working arrangements for the $48-million contract for the construction of the dam, the largest single contract in Bureau history. Through his hands passed the multitude of estimates, contract earnings data, orders to contractors, statistics and reports, correspondence, construction material records, maps and drawings. At the peak of construction more than 5,000 men were employed at the dam site having an aggregate monthly payroll of a half million dollars. The scope of the work of this period intensified the efforts of Mr. Page and his staff.

Despite the intensity of the work and its exacting demands on his skills and energies, largely through his efforts harmonious working relationships were maintained between the Bureau's staff and the contractor's forces. His affability and tact were called upon repeatedly to resolve problems of mutual concern to contractors and Bureau engineers. He established the precedent of friendly relationships for the visitation of dignitaries and the public to Hoover Dam, which is now the mecca for hundreds of thousands of tourists each year.

Characteristically, his unfailing good humor and friendliness were felt throughout the social life of Boulder City which had grown from a small tent colony in 1931 to an established Government municipality of 6,000 inhabitants in 1934. In the Page tradition his wife and two daughters—Mrs. Mildred Sloan Page and daughters Jean and Mildred—became equally well known in the Reclamation engineering circle of acquaintances for their congeniality and interest in community activities.

Among the frequent visitors to Hoover Dam was Dr. Elwood Mead, Commissioner and "grand old man" of Reclamation. With completion of the dam in 1935 as a vigorous reality on the western scene, Dr. Mead, who had long known of Mr. Page's ability and talents, called him to the Bureau's Washington office to head the Engineering Division and to understudy him for the commissionership. Following the death of Dr. Mead in 1936, President Roosevelt appointed John Page Commissioner in 1937.

As Commissioner Mr. Page's grasp of the Bureau's role in west-wide reclamation and his strong convictions on the value of Reclamation's program added prestige to the Bureau's established reputation of engineering achievement. His integrity and ability engendered loyalty and inspiration in his associates and subordinates. His intimate knowledge of the scope and perspective of Reclamation had immeasurable influence on the members of Congress.

His associates recall that he would frequently appear before congressional committees, presenting the Bureau's detailed annual programs and answering numerous questions entirely from personal knowledge or with only occasional reference to notes. For his abilities and cooperation with congressional committees he was singled out for citation in the Congressional Record.

As Commissioner he gave new incentive and reputation to the engineering profession. He was the advocate of the "Engineer Plus"—the subject of his talk before the Nebraska State Engineering Society in Omaha in 1938. He said, "The times cry loudly for the engineer with a social conscience, both in the service of the Government and in private practice. All branches of the conservation movement need trained engineers with vision."

The wide spread of his responsibilities and the constant demand on his time and energies as Commissioner, particularly during the war years of 1941–42, coupled with his own indefatigable devotion to Reclamation's cause, took a heavy toll of his strength and health. Because of continued failing health, in 1943 he tendered his resignation as Commissioner.

For his brilliant leadership and dedication to the development of western land and water resources, to which he gave his career, his health, and his life, Reclamation pays tribute to the memory of John C. Page by naming him as an illustrious member of the Hall of Fame. # # #

"EACH YEAR over 1,000,000 acres of cultivatable land is going into homesites, industrial and commercial developments, defense establishments, highways, airports, and other nonagricultural uses."—D. A. Williams, Administrator, Soil Conservation Service.

WOMEN VOLUNTEERS WANTED FOR ERA

The Secretary or some other officer of each and every organization of women on our projects is requested to take her pen or typewriter in hand and write to J. J. McCarthy, Editor of Reclamation Era, *and outline her views as to how the* Era *may best serve the interests of our project women. The same invitation is extended to every woman not connected with a women's organization.*

The Era *wishes to be of service to everyone on the projects—men, women, boys, and girls. Just now the call is for women volunteers; without whose cooperation this proposed feature of the* Era *cannot be a complete success. Write today!*

CUTTING O & M COSTS

Continued from page 30

districts. It may be considered a tool in the hands of the irrigation districts enabling them to do a better job at a lower cost.

There is no fixed pattern of operation under a board of control. It is flexible enough to meet all requirements. An outline of a general procedure that might be used is as follows:

A. The newly elected board of control meets and completes their organization, choosing their chairman, method of handling, secretarial work, etc.

B. A superintendent and a staff of operation and maintenance personnel are selected by the board of control and approved by the various irrigation districts.

C. Annually the board of each district, with the assistance of the board of control and the superintendent, will make a survey of their system and determine the work program for the following year.

D. Each irrigation board determines the O&M assessment necessary to meet the program and their proportionate share of the expenses of the operating staff. These general expenses may be divided in some equitable manner, such as on an acreage basis, miles of canals and laterals, the annual budget, etc.

E. The necessary equipment is pooled and placed under the direction of the board of control. This pool may be assembled in whole or in part from the equipment of the various irrigation districts. There are various ways of augmenting this pool in an equitable manner. When equipment is pooled it does not necessarily mean that all equipment is assembled for operating from a single point.

The equipment rates charged to the various jobs are generally set high enough to provide for maintenance, major overhauls, and replacements.

A comparison in cost is made by taking four neighboring irrigation districts that are now operating independently and totaling the annual amount paid out by them for personnel and adding to it the cost of owning and maintaining their entire equipment. Then the assumed cost of the required personnel under operation by a board of control was added to the annual cost of owning and operating a selected list of equipment suitable for a combined operation.

In making this comparison substantial salaries were allowed for the key men under the board of control operation. For instance, a salary of $7,500 was allowed for the superintendent, whereas the average salary for the superintendents of the individual units is approximately $4,500.

In the list of equipment proposed for this consolidated operation were included several units that the irrigation districts could not afford when operating independently. Among these units were a large capacity trailer unit, a dredger, bank slopers, short wave radios, etc. A considerable saving in connection with the equipment is connected with the reduced number of draglines, tractors, etc.

The annual equipment cost included such items as depreciation, storage, insurance, fuel and repairs. The unit costs used are a little over one-half that contemplated for similar equipment when used on heavy construction work. These unit costs seem to be justified by the longer life of equipment used for maintenance work. The indicated saving of 22.8 percent does not include the savings produced by consolidated purchases.

It is recognized that the equipment and the personnel suitable for projects in one part of the country may not be the proper selection for a project of similar size in another area. Local conditions must be considered.

When a consolidation is contemplated, a better than ordinary review is often made of the physical condition of the various units. Emphasis is placed upon delayed work. After a consolidation operation is put into effect these may not be the immediate drop in operating costs expected. The more efficient operation is reflected in the cleaning up of the work long delayed. In this way, an expensive rehabilitation program will be avoided.

With operations carried on under a board of control the time required to be donated by the irrigation boards is greatly reduced. The major portion of the burden is placed upon the superintendent and his key men. When considering organization under a board of control, the importance of a short wave radio in tying together an extended system should not be overlooked.

It seems significant that there is no record of an irrigation district dropping the board of control operation once it is fully organized. # # #

PARKER DAM and powerplant

by WILLIAM M. DOAK
Chief, System Operations Division
Parker-Davis Project Office
Phoenix, Ariz.

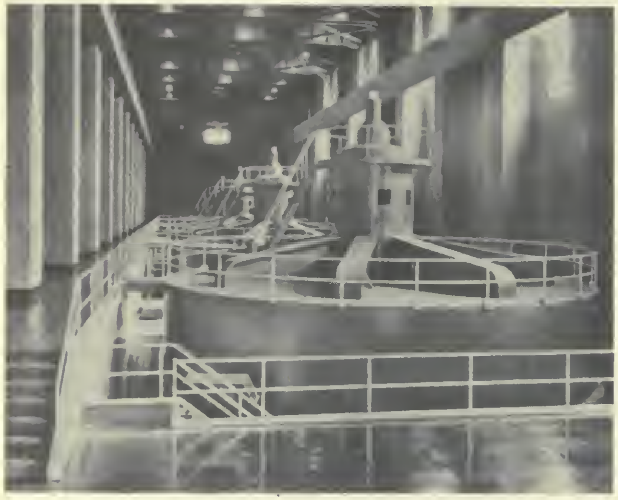
The construction of Hoover Dam, by virtue of its river regulation and power generation, made possible a plan to construct a dam below the mouth of the Bill Williams River to provide a forebay for pumping water into an aqueduct leading to the Los Angeles area.

With funds advanced by the Metropolitan Water District of Southern California, contracts were awarded by the Bureau of Reclamation and the Parker Dam project was started in 1934 and completed in 1938. The Parker Dam Power projects, resulting in the construction of the powerplant proper, was started in 1939 with the first power available from generating units Nos. 1 and 3 in December 1942. But the dam serves other purposes as well. Together with Hoover Dam, and Davis Dam, it also provides flood control along the Colorado. By capturing and delaying the discharge of flash floods and tributaries below Hoover and Davis, such as the Sacramento Wash and Bill Williams River, Parker Dam lessens the chances for flood damage downstream from storms arising in the Davis-Parker reaches of the river. The installation of the flood warning system on the Bill Williams River about 6 years ago permits the operation of Havasu Lake, created by Parker Dam, at a higher average level than previously, and consequently affords greater power generation and irrigation benefits.

Parker Dam is a concrete arch structure with about two-thirds of its structural height below the river bed. Workmen excavated 235 feet before placing its concrete foundation, thus making it the "deepest" dam in the world. Only 85 feet of its bulk protrudes above the bed of the Colorado. Its superstructure rises another 63 feet above the roadway that crosses its top. Almost 380,000 cubic yards of concrete were placed in the structure. At its crest, which is 455 feet above sea level, the dam is 320 feet high, 856 feet long, and 39 feet wide. Its base is 100 feet wide. The crest is controlled by five steel roller gates, each guided

"DEEPEST DAM IN THE WORLD" Parker Dam, Parker Powerplant, and the lower and upper 161-KV Switchyards located at Parker Dam, Calif.

PARKER POWERPLANT GENERATING ROOM as seen from erection platform.



by slots in the spillway pier walls. When lifted by means of huge chains passing over the hoists to counterweights, they permit river water to flow over the spillway. A 15 horsepower motor operates the hoisting unit for each gate. The parts of the piers rising above the roadway and the hoist house on top form the dam's superstructure.

Havasu Lake backs up behind the dam for 45 miles and covers over 24,000 acres. The total capacity of the reservoir is 716,600 acre-feet. The contract between the United States and the Metropolitan Water District for the operation of the dam and reservoir limits the use of active storage to the uppermost 216,500 acre-feet. The depth of the reservoir at the dam is 75 feet with the spillway gates closed.

The Parker Powerplant includes the penstock gate structure, four penstock tunnels, and a powerplant building, housing four hydroelectric generating units, each with a capacity of 30,000 kilowatts. Each of the four tunnels and the penstocks conveying river water from the forebay at the right end of the dam to the turbines is 22 feet in diameter and has a water capacity of 5,500 cubic feet per second. The hydraulic units operate under a gross effective head of 80 feet. # # #

THE EDITOR'S COLUMN

As a followup to Mr. Delbert D. Suggs' article "Weed Control by Grass Competition," which appeared in the February *Era*, we are printing the following items on weed control which we hope may prove helpful to you.

TEN COMMANDMENTS FOR 2,4-D SPRAYING

1. Spray when weeds are small.
2. Learn the right amount of 2,4-D and additive for your area, use no more, no less.
3. Avoid highly susceptible crops such as grapes and cotton—do not drive by the ends of the rows if wind is toward the crop.
4. Use low volatile 2,4-D.
5. Low pressure: 25 pounds at the nozzle.
6. High volumes: 25 to 75 gallons per acre.
7. Wind away from crop, not above 5 m. p. h.
8. Boom low to ground; not over 24 inches above weeds.
9. Keep outside of sprayer clean.
10. Store or park sprayer away from susceptible vegetation; bury empty containers—don't throw in the city dump.

* * * *

A $25 investment in grass seedings can save you up to $5,000. It is no gamble when you can seed a mile of farm head-ditch to a sod-forming grass and remove the dominant source of barnyard grass seed. Farmers have spent up to $100 per acre to clean the grass from beans or sugar beets. Check with your county agent for a nonweedy sod-former.

* * * *

Over a 5-year period you can establish grass on ditchbanks where rainfall is only 6–8 inches for about the same cost as the control of annual weeds with 2,4-D. After that, it's all gravy.

* * * *

Anytime you have to drag and burn a ditchbank to clean up, you are seeding next year's crop of the same weeds. Try grass, and before long beef or wool can be your crop.

* * * *

The facts are that establishing a grass stand on arid ditchbanks requires an all-out effort in the very brief periods of favorable weather. Native grasses survive under low rainfall, so take your cue from Mother Nature. Do like she does—make grass seedings to take advantage of the limited times of favorable conditions.

* * * *

Cattails make pretty dry bouquets. They make summer "snow storms" of downy seed. But this is what counts: Cattails use twice as much water as most crops. A 1,000 acres of cattails use up about 8,000 acre-feet of water each year. Prevention of cattail colonies saves irrigation water.

* * * *

Cooperative Research in SUGAR BEETS

by BION TOLMAN
General Agricultural Superintendent
Utah-Idaho Sugar Company
Salt Lake City, Utah

HARRY KLAHR proudly shows his sister-in-law Mrs. James Klahr and Nephew Jack Rees a 30 pound sugar beet grown on his farm near Notus, Idaho. ***Photo by Stan Rasmussen, Region 1.***

Developments in sugar beet production in the United States have taken place so rapidly during the past 15 years that published accounts of them are frequently out of date before they are printed and read by the public. Every year has seen significant developments in machinery for handling the crop in cultural practices such as fertilizer use, irrigation and weed control; and in the breeding of varieties possessing higher yielding ability, improved disease resistance and higher quality. All of these significant developments have been brought about through cooperative research. This cooperative research has involved research workers from almost every company within the sugar beet industry as well as from the various sections and branches of the Agricultural Research Administration of the United States Department of Agriculture and research personnel from numerous State experiment stations.

When development of machinery for handling the crop was a major issue, research personnel from the machinery manufacturing industry also became members of the cooperating group, and the same type of cooperative program has been followed on problems relative to fertilizer use, insecticide use, and the development of herbicides for weed control.

Cooperation between all the agencies which are concerned in solving problems of the industry is cleared through the Beet Sugar Development Foundation, a nonprofit organization. All sugar beet companies in the United states are members of the B. S. D. F. This central organization, through its elected Board of Directors, executes memoranda of understanding covering cooperative work with public research organizations such as the United States Department of Agriculture and State Experiment Stations. This organization also expends a budget in excess of $100,000 per year to further cooperative projects with emphasis placed on those of most concern to the entire industry. At the present time the Suger Beet Industry is giving financial assistance through the Sugar Beet development foundation to the Sugar Crops Section of the United States Department of Agriculture at its field stations in Colorado, Utah, and California; and at the research station at Beltsville, Md. These projects deal principally with providing basic materials and methods for use in the production of hybrid varieties of sugar beets adapted to the needs of the various sections of the country.

Projects for control of sugar beet pests and diseases are receiving considerable attention at the present time. These projects include control of Sugar Beet Nematode, Virus Yellows, and continue work on Curly-Top, Leafspot, and root rot. These are diseases which have received major emphasis in the past and on which considerable progress has been made. The work on sugar beet nematode control involves four organizations: the sugar beet industry, the United States Department of Agriculture, the University of California, and various chemical companies. Each carries

some particular phase of the overall project and the Beet Sugar Development Foundation serves as the coordinating agency.

Work on the nutritional requirements of sugar beets also involves the sugar beet industry, the United States Department of Agriculture, and State Experiment Stations. This project includes such problems as: critical levels of the various elements needed in sugar beet nutrition; development and evaluation of soil and plant tissue tests to help in determining fertilizer requirements and the inter-relation of fertilizer application to the irrigation program and the crop rotation system.

Progress From Research

The real proof of the value of such a coordinated and industry-wide supported program of research lies, of course, in the results. Some of the outstanding achievements of the past 15 years might be summarized as follows:

1. Rapid strides have been made toward complete mechanization of the crop. During this period, machine harvesting has become the common practice on 97 percent of the beet acreage. Through the use of processed seed and the use of precision planters seeding rates per acre have been reduced from 16 to 18 pounds of whole seed per acre to from 6 to 7 pounds of processed seed per acre. This has resulted in a large reduction in spring labor requirements. More recently, thinning machines have been developed and some districts have made extensive use of them. In 1955 approximately one-third of the sugar beet acreage in the United States was machine worked and thinning and hoeing completed by laborers using long-handled hoes and doing a minimum of finger work. This procedure has cut labor costs to the farmer and to the sugar companies and it has resulted in increased earnings to the laborers.

The development of monogerm seed, which is rapidly approaching commercial use, will still further facilitate mechanization of the spring work.

2. Average yields per acre have been increased about 26 percent. This has resulted from varieties improved in disease resistance and in yielding ability; improved soil fertility practices; improved irrigation practices; and a general improvement in farming practices due to numerous technological improvements.

3. Among the great benefits coming from the cooperative research program has been the development of disease resistant varieties. Development of curly-top resistant varieties not only saved the industry in the area west of the Rocky Mountains but it has made it possible to rebuild factories in areas from which the sugar beet industry had previously been driven.

Leaf-spot resistant varieties have stabilized and made more profitable, both to the farmer and to the processor, the sugar-beet crop in States east of the Rocky Mountains, including States as far east as Michigan and Ohio.

At the present time varieties are being developed with combined resistance to curly-top, leaf spot and root rot.

Furthermore, the sugar beet industry is now on the threshold of another great development in sugar beet production. Hybrid varieties are now being produced and tested on a commercial scale. Extensive field trials have demonstrated that the use of hybrid varieties may increase sugar-beet yields another 20 to 25 percent.

Although the accomplishments of the cooperative program on sugar beets have been tremendous and remarkable strides have been made, there still remains many problems to solve and much work to be done. Officials in the sugar beet industry are confident that in the future as well as in the past, our fastest and our best progress will be made through the joint efforts of all the individuals and organizations concerned with this important agricultural crop. # # #

L. H. MITCHELL DIES

L. H. Mitchell, former Irrigation Adviser to the Secretary of the Interior, died in San Diego, Calif., on January 24 after a brief illness.

Mr. Mitchell spent 41 years with the Bureau of Reclamation serving as project manager on the Riverton, Shoshone, and Lower Yellowstone projects. The educational work he did on water utilization and weed control in the arid west is well known.

After graduating from the University of Maine, Mr. Mitchell joined the Bureau of Reclamation where he worked continuously until his retirement in 1945. #

JAKE AND THE RUSSIAN THISTLE

The most efficient water measuring device will always have to be supplemented by human assistance, as the following true story illustrates. Some years ago, during a dry season on the North Platte project, water was allotted in proportion to acreage. Two farmers we'll call Jake and Joe got their water at the end of a lateral, each through a submerged orifice.

For several mornings hand-running, the ditchrider found and removed a large green Russian thistle from Joe's headgate, where it had the effect of increasing the flow through Jake's gate. The ditchrider mentioned the coincidence, not to Joe but to Jake, and added, "You know, it's sure strange that green thistles would blow this time of year."

A few mornings later, Joe's gate again was clogged—with a huge dry thistle. The moral? The best measuring device requires constant care. ●

WATER OUTLOOK

Continued from page 40

for projects along the Colorado River main stem, including the Yuma and Wellton-Mohawk Valleys.

BRITISH COLUMBIA.—According to the British Columbia Water Rights Branch, most snow courses in the Columbia, Kootenay, Okanagan-Similkameen and Skagit River Basins have water content which averages about 35 percent above normal. The low level snow courses show the greatest amount above normal. Thawing appears to have started in the most southern areas. April to September streamflow in these areas is expected to be well above normal. Flows greater than last year, but not as great as in 1954, are expected.

Snow pack in the Fraser and North Thompson River Basin is heavy, particularly in the North Thompson which is more than 40 percent above normal.

CALIFORNIA.—Water supply conditions in California as of April 1, as reported by the State Division of Water Resources, are generally satisfactory north of latitude of Bakersfield. Though precipitation was considerably below normal during February and negligible during March, the record-breaking storms in December and January resulted in sufficient snow pack and surface reservoir storage to provide above normal water supplies for this portion of California. Shortages in water supply are anticipated only in localized areas where development of conservation storage and groundwater basins has not kept pace with growth. In the remainder of the State, conditions are generally unsatisfactory. Pumping from groundwater basins supplemented by supplies conserved by facilities of the Central Valley project and on the Colorado River will alleviate to a large extent shortages in local surface water supplies. However, the available supply for agricultural areas in the vicinity of San Diego will be greatly deficient. The demand on ground water basins to compensate for the deficiency in surface supplies will further aggravate overdraft conditions in basins located in the western and southern portions of the San Joaquin Valley and in the south coastal area. Unless provision is made in the near future for further supplemental supplies a critical situation will result.

There were no storms of consequence during March. Those which occurred during the last few days of the month brought only normal amounts to scattered portions of the State north of the Tehachapi Mountains. However, seasonal precipitation as of April 1 averages above normal in all the major hydrographic areas of California, except the south coastal which is generally greater than for the same period 1 year ago.

The water content of the snow pack in the Cascade Mountains and Sierra Nevada varies from 20 percent normal on the Tule River to 150 percent normal on the Upper Sacramento and Feather River watersheds. The March storms deposited only minor amounts of new snow and the water content of the snow pack is generally less than that of March 1 as a result of some melt which occurred during the latter portion of March.

New high river flows were reported on many streams during March. However, reported inflow to Shasta, Folsom and Pine Flat Rivers indicated major increase in flow during March due to snow melt in the upper reaches of the respective tributary watersheds. Snow melt runoff on the Cascade Mountains and Sierra Nevada streams will be considerably in excess of that during 1955. The anticipated snow melt runoff assuming normal precipitation during the April-July period is expected to vary from 60 percent of average in the Tule River to 156 percent on the Feather River and on most streams will be approximately double that for 1955.

COLORADO—Except for the Rio Grande, the outlook for the State is much improved over the past 2 years. Early season snowfall was much above normal throughout the State, but increase in the snow pack during March was small and warm temperatures caused premature melting. On the Colorado River drainage, mountain soils under the snow are wet. Streamflow is increasing. While the snow pack has melted to some extent at medium elevations of the eastern slope, wet soils and increased streamflow are not in evidence.

On the South Platte drainage in northeastern Colorado, snowmelt season streamflow will range from normal to about 25 percent above normal. Along the Arkansas River, the available supply will be nearly 75 percent of normal. Supplies will be generally adequate along the main streams of the Colorado River drainage. Streamflow should range from 75 percent of normal in southwestern Colorado to 125 percent of normal on the Upper Colorado River near the Continental Divide. Inflow to Lake Mead is expected to be near average; approximately equal to the total combined flow of 1954 and 1955.

The outlook for the Rio Grande drainage in Colorado is slightly improved over the past 2 years, but the supply

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Water Stored in Western Reservoirs

(Operated by Bureau of Reclamation or Water Users except as noted)

Location	Project	Reservoir	Storage (in acre feet)		
			Active capacity	March 31, 1955	March 31, 1956
Region 1	Baker	Thief Valley	17,400	13,100	18,900
	Bitter Root	Lake Como	34,800	6,000	17,400
	Boise	Anderson Ranch	423,200	193,500	115,200
		Arrowrock	286,600	216,600	182,600
		Cascade	654,100	65,100	211,700
		Deadwood	161,900	71,600	84,500
		Lake Lowell	169,000	142,000	143,200
	Burnt River	Unity	25,200	4,400	18,400
	Columbia Basin	F. D. Roosevelt	5,072,000	749,000	4,123,000
		Equalizing	761,800	452,500	742,700
		Potholes	470,000	72,600	258,000
	Deschutes	Crane Prairie	55,300	49,000	50,000
		Wickiup	187,300	194,000	200,000
	Hungry Horse	Hungry Horse	2,982,000	1,708,600	1,637,900
	Minidoka	American Falls	1,700,000	1,705,000	1,456,200
		Grassy Lake	15,200	12,300	12,700
		Island Park	127,200	132,600	110,300
		Jackson Lake	847,000	473,800	325,200
		Lake Walcott	95,200	73,200	96,300
	Ochoco	Ochoco	47,500	23,200	41,700
	Okanogan	Conconully	13,000	6,200	8,500
		Salmon Lake	10,500	10,100	9,500
	Owyhee	Owyhee	715,000	209,200	550,500
	Umatilla	Cold Springs	50,000	42,300	49,400
		McKay	73,800	20,200	57,900

Water Stored in Western Reservoirs—Continued

Location	Project	Reservoir	Storage (in acre feet)		
			Active capacity	March 31, 1955	March 31, 1956
Region 1	Vale	Agency Valley	60,000	27,600	49,400
		Warm Springs	191,000	33,700	115,100
	Yakima	Bumping Lake	33,700	19,600	3,200
		Cle Elum	436,900	332,100	181,100
		Kachess	239,000	206,600	141,900
		Keechelus	157,800	109,600	54,200
		Tieton	198,000	140,700	95,600
Region 2	Central Valley	Folsom	920,300	0	391,700
		Keswick	20,000	17,900	19,300
		Lake Natoma	8,800	0	8,300
		Millerton Lake	427,800	214,400	112,000
		Shasta	3,998,000	2,914,100	3,382,500
		Vermillion	125,100	51,700	(2)
	Klamath	Clear Lake	513,300	235,600	430,800
		Gerber	94,300	36,800	77,000
		Upper Klamath Lake	524,800	408,900	394,100
	Orland	East Park	50,600	34,700	50,200
		Stony Gorge	50,000	26,600	28,600
Region 3	Boulder Canyon	Lake Mead	27,207,000	11,558,000	10,720,000
	Davis Dam	Lake Mohave	1,809,800	1,755,000	1,718,000
	Parker Dam Power	Havasu Lake	688,000	630,000	616,000
	Salt River	Bartlett	179,500	57,000	68,000
		Horse Mesa	245,100	243,000	231,000
		Horseshoe	142,800	1,000	2,000
		Mormon Flat	57,900	56,000	57,000
		Roosevelt	1,381,600	401,000	229,000
		Stewart Mountain	69,800	68,000	66,000
Region 4	Eden	Big Sandy	38,300	9,800	9,800
	Fruitgrowers Dam	Fruitgrowers	4,500	3,100	2,300
	Humboldt	Rye Patch	190,000	10,800	40,200
	Hyrum	Hyrum	15,300	12,200	11,600
	Mancos	Jackson Gulch	9,800	3,000	2,200
	Moon Lake	Midview	5,800	5,700	5,200
		Moon Lake	35,800	11,900	11,200
	Newlands	Lahontan	290,900	186,800	197,400
		Lake Tahoe	732,000	360,000	480,000
	Newton	Newton	5,300	2,200	3,100
	Ogden River	Pineview	44,200	4,900	4,200
	Pine River	Vallecito	126,300	58,500	48,000
	Provo River	Deer Creek	149,700	81,031	86,600
	Scofield	Scofield	65,800	11,500	8,700
	Strawberry Valley	Strawberry Valley	270,000	175,880	152,600
	Truckee Storage	Boca	40,900	794	10,400
	Uncompahgre	Taylor Park	106,200	54,085	40,600
	Weber River	Echo	73,900	27,500	37,400
Region 5	W. C. Austin	Altus	162,000	16,200	35,700
	Balmorhea	Lower Parks	6,500	6,200	6,200
	Carlsbad	Alamogordo	122,100	82,600	85,000
		Avalon	6,000	2,000	900
		McMillan	38,700	28,900	32,100
	Colorado River	Marshall Ford	1,835,300	496,600	706,600
	Rio Grande	Caballo	340,900	14,300	10,700
		Elephant Butte	2,185,400	139,600	181,200
	San Luis Valley	Platoro	60,000	0	0
	Tucumcari	Conchas [1]	465,100	43,900	161,100
Region 6	Missouri River Basin	Angostura	92,000	48,500	8,400
		Boysen	710,000	268,700	2,500
		Canyon Ferry	1,615,000	749,300	1,154,500
		Dickinson	13,500	4,300	5,400
		Fort Randall	3,900,000	1,870,900	1,586,500
		Heart Butte	218,700	56,800	68,400
		Keyhole	130,000	15,000	20,800
		Shadehill	300,000	77,800	84,400
	Belle Fourche	Belle Fourche	185,200	68,000	98,800
	Fort Peck	Fort Peck [1]	14,877,000	4,573,400	416,700
	Milk River	Fresno	127,200	76,200	93,500
		Nelson	66,800	47,500	38,500
		Sherburne Lakes	66,100	19,900	23,100
	Rapid Valley	Deerfield	15,100	10,900	10,600
	Riverton	Bull Lake	152,000	62,200	55,300
		Pilot Butte	31,600	26,400	23,300
	Shoshone	Buffalo Bill	380,300	133,800	117,200
	Sun River	Gibson	105,000	69,000	74,600
		Pishkun	30,100	19,200	16,300
		Willow Creek	32,400	25,300	28,200
Region 7	Colorado-Big Thompson	Carter Lake	108,900	64,900	53,000
		Granby	465,600	82,000	31,100
		Green Mountain	146,900	34,900	40,500
		Horsetooth	141,800	8,300	69,300
		Shadow Mountain	1,800	1,400	1,300
	Missouri River Basin	Bonny	167,200	38,400	38,700
		Cedar Bluff	363,200	41,800	74,900
		Enders	66,000	35,000	35,300
		Harlan County [1]	752,800	91,900	92,600
		Harry Strunk Lake	85,600	30,200	24,700
		Swanson Lake	249,800	36,500	60,000
	Kendrick	Alcova	24,500	5,800	3,600
		Seminoe	957,000	257,100	212,800
	Mirage Flats	Box Butte	30,400	17,500	19,500
	North Platte	Guernsey	39,800	32,000	32,400
		Lake Alice	11,200	0	1,200
		Lake Minatare	59,200	14,100	15,600
		Pathfinder	1,010,900	476,000	464,400

[1] Corps of Engineers Reservoir.
[2] Not reported.

Water Outlook

Continued from page 51

will be less than normal and short of demand. This will further complicate interstate division of waters from this stream.

Soil moisture in irrigated areas is good on the west slope and fair to good in eastern Colorado. This represents a material improvement over 1955.

IDAHO—Northern Idaho has a recordbreaking snow pack which means an excellent water outlook, with probability of excessive high flow on the Kootenai, Clearwater, Salmon, and Payette Rivers. Boise River also has an extremely heavy snow pack, but wise reservoir operations are expected to control its flow in 1956.

In southern Idaho the snow pack is close to normal with average supplies forecast. The drought that had prevailed in this area for several years is definitely broken. Reservoir storage is good throughout the State as a result of heavy winter streamflow. The handicap of a low carry-over storage from last year has been overcome. In most drainages in the southern edge of the State storage is now above normal except where it has been lowered in preparation for the expected heavy flows.

KANSAS—The outlook for the Arkansas River in western Kansas is only fair but slightly improved over a year ago, with about 40,000 acre-feet in the John Martin Reservoir. Soils are dry. Summer precipitation will have to be above normal to provide adequate water.

MONTANA—Over Montana's mountainous areas, the snow pack is 15 to 30 percent more than average. In Jefferson River Basin it is 50 percent more than in 1955 and 14 percent above average. Madison River surveys show 23 percent more than in 1955, and 15 percent above average. In Gallatin River Basin the pack is 26 percent over last year's and 19 percent more than in the average year.

Tributaries to the main stem of the Missouri River have a snow pack that is 13 percent more than in 1955 and 7 percent more than average. Flow of the Missouri into Fort Peck will be about 5,500,000 acre-feet, 27 percent more than in the average season. There is a very heavy pack in the Yellowstone River Basin, 60 percent more than in 1955, and 37 percent more than average. It is indicated that 5,100,000 acre-feet will flow past Billings from April to September. At Williston, N. Dak., the flow of the combined Missouri and Yellowstone Rivers will send 14 million acre-feet into Garrison Reservoir. In this flow 5½ million acre-feet will be subject to regulation at Fort Peck on the Missouri proper.

Over the Columbia River Basin in Montana, water equivalent in the snow pack is considerably more than it was in 1955, 36 percent more on the Flathead and 42 percent more in the Clark Fork Basin. Flow into Hungry Horse Reservoir is expected to be a half-million acre-feet more than it was in 1955. At Cabinet Gorge, on the Idaho-Montana line, flow is forecast at 15,300,000 acre-feet, 26 percent more than average.

There is an extremely heavy snow pack in the Kootenai River Basin in northwestern Montana. It is close to the record pack in 17 years of reporting. Extremely high flows are clearly indicated for downstream reaches of this river.

NEBRASKA—Available supplies along the North Platte in western Nebraska will be at least average. Soil moisture conditions are good in valley areas. The outlook for irrigated sections on the Kansas River watershed, served by water stored in Bonny, Swanson Lake, Enders, Harry Strunk and Harlan County Reservoirs, is good to excellent with adequate storage to meet expected demands.

NEVADA—Irrigation season supplies in Nevada range from excellent along the eastern slope of the Sierras, to good along the Humboldt in northern Nevada, and very poor in the southern portion. Winter streamflow has been above normal in the north and western parts. Mountain soils are well saturated. April 1 storage in irrigation reservoirs was 60 percent of capacity and 97 percent of the April 1, 1938–42 average.

Streamflow from the east-central portion of the Sierras will range from 120 to 130 percent of average. Nearly normal flow will occur along the Humboldt and its tributaries in the north. In the southern part of the State, ground water recharging from the snow pack will be deficient.

NEW MEXICO—Drought conditions and prospective shortages continue along the Rio Grande. Total storage and expected runoff indicate a water supply of about 25 to 40 percent of normal for irrigated districts served by the Rio Grande. The 1956 outlook is very similar to that during 1954 and 1955. Early season snow pack, particularly on the Colorado portion of the watershed, was very encouraging. However, lack of snow in March, and warm temperatures, reduced the situation to a current poor rating.

Outlook on the Carlsbad and Tucumcari project is fair to good. This outlook is based on carryover storage and fair to good soil moisture conditions rather than on snow-melt season runoff. The runoff of the San Juan through New Mexico is expected to be about 75 percent of normal and adequate for local demands.

OKLAHOMA—Altus Reservoir on the W. C. Austin project contains 36,000 acre-feet, about 50 percent of normal. Reservoir inflow is much below normal. The outlook is only fair.

OREGON—Oregon's agricultural areas, including those pinched by water shortages in 1955, will have ample supplies in 1956. An unusually heavy snow pack, and the wettest watershed soils observed in many years, assure better than average late summer streamflow throughout the State.

Reservoired water supplies are 17 percent greater than average in 20 important reservoirs. Although water stored behind these dams averages 80 percent of capacity, many are spilling to make room for unusually heavy streamflow yet to come.

Forecasts of seasonal streamflow foretell average to well above average supplies in April through September discharge. Many streams in the Malheur, Burnt, Imnaha, Wallowa, Grande Ronde, John Day, Deschutes, Hood, Willamette, Umpqua, Rogue, Klamath, Chewaucan, and Warner Lake Basins will produce flows ranking in the top 10 percent of the highest historical records.

Some areas are planning to use "bonus" flows to build reservoir reserves for 1957. Others are cultivating marginal irrigated lands that go out of production in short water years.

SOUTH DAKOTA—The Black Hills snow pack is extremely low, indicating a shortage of water for irrigation. Storage in reservoirs serving the Black Hills irrigated districts gives a little better outlook. It is 109 percent of normal and 64 percent of usable capacity.

TEXAS—The irrigated areas of west Texas along the Rio Grande will again be very short of water. Elephant Butte Reservoir contains about the same amount of water as it did last year, less than 20 percent of normal. Total streamflow available for irrigation will probably not exceed 25 percent of normal, similar to the situation a year ago.

On the Pecos River the outlook is fair to good with 100,000 acre-feet in storage in Red Bluff Reservoir as compared to a normal of about 85,000 and 162,000 a year ago.

UTAH—The February and March drought has largely eliminated any serious danger of damaging peak flows during spring runoff in northern Utah. Water users there can look for fair to good water supplies, ranging from around 30 percent below to 20 percent above average. In southern Utah the recent dry weather has created a critical water shortage on most streams, particularly for irrigated areas along Sevier River. At Kingston gaging station. April–September runoff is expected to be only one-fifth of average, slightly more than was measured in

Continued on page 4 of cover

COLORADO RIVER STORAGE PROJECT HEADS NEW RECLAMATION AUTHORIZATIONS

"SIGNING INTO LAW BY PRESIDENT EISENHOWER of the Colorado River Storage Project authorizing legislation, is an historic milestone in the annals of the Upper Colorado River Basin States and of the Nation," Secretary of the Interior Douglas McKay said on April 11, 1956.

"It is gratifying to see the way cleared for construction of this great project. Future generations will owe a debt of gratitude to the President and the Congress for their conservation foresight in enacting this legislation," said Secretary McKay.

Reclamation Commissioner W. A. Dexheimer said, "Even though we proposed to start construction immediately, it will not be completed and fully operative in our time."

Comprehensive development of the water resources of the Upper Colorado River Basin has been initiated by authorization of the Colorado River storage project and participating projects.

A full or supplement irrigation water supply for more than 366,000 acres of land, installed hydroelectric power capacity of about 1,100,000 kilowatts and other multiple benefits are contemplated by the authorized construction. Several decades will be required to bring the comprehensive basin development to fruition.

The construction of four major multipurpose reservoir storage units and 11 participating Reclamation projects in the States of Colorado, New Mexico, Utah, and Wyoming is authorized. The Secretary of the Interior is also instructed to give priority to investigations and preparation of planning reports for an additional 25 irrigation projects. This initial authorization of projects and priority in planning, however, is without intent of the Congress to interfere with or preclude consideration and authorization of other additional projects in the comprehensive plan of development.

The upper Colorado development is the largest Reclamation project in point of dollar authorization ever to be approved by the Congress in a single, specific piece of legislation.

The Act authorizes appropriation of not more than $760,000,000 for construction of the initially authorized development of the Upper Colorado River storage project. A separate fund in the United States Treasury, known as the Upper Colorado River Basin Fund, is established for construction, operation, and maintenance of the units and projects.

Funds appropriated by the Congress will be credited to the Basin Fund as advances from the Treasury. Project revenues also will be credited to the Fund and those in excess of operating needs will be paid annually to the United States Treasury to return construction costs allocated to power and municipal water supply, both with interest, and costs of the storage units allocated to irrigation without interest within 50 years after completion.

Project revenues in excess of those required for the foregoing needs will be apportioned among the States of the upper division as follows: Colorado—46%, Utah—21.5%, Wyoming—15.5%, and New Mexico—17%, except that revenues in the Fund from any participating project are apportioned to the State in which the project is located. Such apportioned revenue is to be used only to assist in repaying irrigation construction costs of participating projects in the State to which apportioned. The Secretary will submit business-type budgets annually to the Congress covering the Basin Fund operations.

Construction, operation, and maintenance of the units and participating projects will be governed by Federal Reclamation laws, and operation of these facilities will be in accordance with the

Mexican Water Treaty, the Colorado Basin Compact, the Upper Colorado River Basin Compact, and other documents which are commonly referred to as the law of the Colorado River.

Contracts to provide for repayment of irrigation water users' obligations, within 50 years exclusive of a development period and for irrigation distribution systems, are required prior to construction of the participating projects.

For a period of 10 years following enactment of the legislation, no water from any participating projects authorized by this legislation is to be delivered to new lands for production of any basic commodity as defined by the 1949 Agricultural Act which is in excess of normal supply unless the Secretary of Agriculture calls for such production in the interest of national security.

Public recreation facilities and facilities to mitigate losses and propagate fish and wildlife are also authorized by the legislation.

Two other reclamation projects were authorized by the Congress for construction. These were the Washita River Basin in West Central Oklahoma and the Ventura in Southwestern Ventura County, California.

The Washita project will provide vitally needed irrigation water to approximately 26,000 acres of land, supply municipal and industrial water to several nearby towns, and aid in the control of floods estimated to do an average $1,200,000 worth of damage yearly. The project will also have significant recreational and fish and wildlife benefits.

Major features of the project will include Fort Cobb Reservoir, created by an earthen dam on Pond (Cobb) Creek, 35 miles southeast of Clinton, and Foss Reservoir. Other features include a small diversion dam, canals, and pipelines.

The Ventura project is designed to supply irrigation water to about 12,000 acres of land and to meet growing municipal and industrial water needs.

Major features of the project include the Casitas Dam, an earth structure about 2 miles upstream on Coyote Creek from its junction with Ventura River. Robles Diversion Dam, a rockfill structure on Ventura River to divert additional water into Casitas Reservoir; and a main conduit system to take water to elevations higher than the reservoir. The project will also provide minimum recreational facilities. ###

LAND JUDGING CONTESTS ARE SCHEDULED

The Fifth National Land Judging and the Second National Range and Pasture Judging Contests will be held May 4, 1956, at the State Fairgrounds, Oklahoma City, Okla. This contest is sponsored by Station WKY AM–TV and business men of Oklahoma City.

On May 3, 1956, a detailed school of instruction is scheduled for both the land and the range and pasture judging contests for all out-of-State participants who wish to make a study of soil and pasture conditions in Oklahoma.

There will be five divisions for contestants: 4–H, FFA, women and girls, collegiate, and adults. Awards in the form of money, medals, trophies, and plaques will be presented the contest winners.

Further information concerning these events may be obtained from Jack Stratton, Farm Director of Radio Station WKY, Oklahoma City, Oklahoma. #

WHAT'S NEW IN WEED CONTROL EQUIPMENT

The most efficient weed control equipment yet devised is finding more and more use on irrigation systems. The equipment is at a premium and in constant demand. Some of its important features are: (1) Self-propelled, (2) fully automatic, (3) use a wide variety of cheap fuels, (4) equally effective against grasses and broadleaf weeds, (5) year-round usefulness, and (6) high trade-in value. The equipment can be purchased at any sales barn under the name cow.

Cows pastured on grassed ditchbanks provide the cheapest and best weed control possible. Grazing should be controlled to insure that the grass stand maintains vigor. Overgrazing quickly eliminates the grass and weeds take over; no grazing causes the grasses to make a rank growth with the result that they slow up flow and cause silt to settle out. Try the one-two-three punch on weeds: (1) seed ditchbanks to grass, (2) get some cows, (3) control grazing. ●

"GET ACQUAINTED" COPIES

If you have friends or associates who would be interested in the Reclamation Era, please send their names and addresses to the Bureau of Reclamation, Washington 25, D. C. We shall be glad to send them copies of back issues.

USE BLASTING POWDER FOR EXCAVATING

Blasting powder or dynamite is not in general use for excavating canals and drains in connection with irrigation. However, the management of some irrigation systems have found dynamite very beneficial toward maintaining various phases of their units. It would seem that its use should receive wider recognition.

In some instances short stretches of canals or drains can be completed by using powder at a cost lower than required for moving heavy equipment to the job. Powder is found to be especially advantageous in wet or bogged areas.

The following are examples of jobs where the use of powder may be found especially economical:

- Channel changes
- Cutting of drains through bogged areas
- Cleaning of drains through bogged areas
- The excavation of short channels in isolated areas

The amount of powder required will vary considerably but one pound of dynamite per cubic yard of excavation will meet the requirements in some instances.

MAJOR RECENT CONTRACT AWARDS

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DS-4509	Central Valley, Calif.	Jan. 10	2 25,200-kvar shunt capacitors for Folsom-Elverta terminal switching facilities.	Tobe Deutschmann Corp., Norwood, Mass.	$225,160
DS-4512	Provo River, Utah	Mar. 6	2 2,750-kv.-a. vertical-shaft generators for Deer Creek powerplant.	Elliott Co., Jeannette, Pa.	145,402
DC-4536	Gila, Ariz.	Mar. 9	Construction of earthwork, concrete lining, and structures for Ralph's Mill area, Mohawk laterals.	Marshall and Haas, Yuma, Ariz.	1,164,494
DS-4537	Yakima, Wash.	Feb. 3	One 18,000-hp. vertical-shaft hydraulic turbine for Roza powerplant.	Baldwin - Lima - Hamilton Corp., Philadelphia, Pa.	222,000
DC-4551	Palo Verde Diversion, Calif.-Ariz.	Jan. 9	Construction of Palo Verde diversion dam	W. E. Kier Construction Co., El Segundo, Calif.	2,009,760
	do	Feb. 2	Construction of Palo Verde levee system	Euclid Construction Co., Inc., Phoenix, Ariz.	1,012,097
DC-4553	Yakima, Wash.	Jan. 4	Constructioa of Roza powerplant	Hall-Atwater, Inc., Seattle, Wash.	572,764
DC-4555	Solano, Calif.	Jan. 31	Construction of earthwork, concrete canal lining, and structures for Putah South canal.	A. Teichert & Son, Inc., Sacramento, Calif.	1,147,921
DC-4565	Columbia Basin, Wash.	Jan. 19	Construction of earthwork, concrete lateral lining, and structures for East Central part of Block 89 laterals, wasteways, and drain, West canal laterals.	Henry C. Werner and Tauf Charneski, Eugene, Oreg.	546,919
DS-4567	do	Jan. 13	8 horizontal centrifugal-type pumping units for Evergreen pumping plant, Block 77 of West canal laterals.	Fairbanks, Morse & Co., Kansas City, Mo.	144,877
DC-4571	do	Feb. 7	Construction of earthwork and structures for PE16.4 and PE46A wasteways and county road relocation for Block 19 of Potholes East canal laterals.	Henry C. Werner and Tauf Charneski, Eugene, Oreg.	523,655
DC-4577	Central Valley, Calif.	Feb. 9	Construction of Shafter-Wasco laterals, Shafter-Wasco irrigation district, Friant Kern canal distribution system.	R. V. Lloyd & Co., Coachella, Calif.	1,849,118
DC-4580	Fort Peck, Mont.	Jan. 19	Construction of 13.4 kv. miles of Fort Peck-Whately 69 kv. transmission line.	Van Daveer & Co., Billings, Mont.	103,092
DC-4584	Columbia Basin, Wash.	Feb. 16	Construction of earthwork, concrete lateral lining, and structures for Part 3 of Block 18 laterals and wasteways, East Low canal laterals.	Cherf Bros., Inc., and Sandkay Contractors, Inc., Ephrata, Wash.	416,897
DC-4585	Middle Rio Grande, N. Mex.	Feb. 20	Construction of Atrisco feeder canal	McGinnes Bros., Inc., Houston, Tex.	283,375
DC-4587	Missouri River Basin, Kans.	Feb. 14	Construction of earthwork and structures, laterals, sub laterals, and adjacent drains.	Claussen-Olson Benner, Inc., and Korshoj Construction Co., Holdrege, Nebr.	914,439
DC-4588	Middle Rio Grande, N. Mex.	Jan. 19	Channelization of the Rio Grande, Espanola area, Espanola to Guique diversion dam.	James P. Johnson, Sante Fe, N. Mex.	147,760
DC-4589	Missouri River Basin, N. Dak.	Feb. 10	Construction of 80 miles of Fargo Grand Forks 115 kv. transmission line.	Crawford Electric Co., North Platte, Nebr.	710,659
DC-4590	Columbia Basin, Wash.	Feb. 16	Construction of earthwork, concrete and soil cement-lateral lining, and structures for West Central part of Block 89 laterals and wasteways, West canal laterals.	Henry C. Werner and Tauf Charneski, Eugene, Oreg.	598,472
DC-4591	Middle Rio Grande, N. Mex.	Jan. 23	Rehabilitation of San Acacia diversion dam	Claussen-Olson Benner, Inc., Holdrege, Nebr.	104,000
DC-4595	do	Feb 9	Channel prototype channelization of the Rio Grande in Casa Colorado area.	Miller & Smith, Contractors, Albuquerque, N. Mex.	146,624
DC-4603	Missouri River Basin, S. Dak.	Mar. 8	Construction of Granite Falls substation	Basin Construction Co., Omaha, Nebr.	319,515
DC-4613	Deschutes, Oreg.	Mar. 21	Construction of Haystack dam	R. A. Heintz Construction Co., Portland, Oreg.	721,802
400C-58	Grand Valley, Colo.	Jan. 27	Construction of penstocks and radial gate check for Orchard Mesa powerplant and pumping plant and siphons and wasteways for High lift and Low lift canals.	Foutz and Bursum Construction Co., Inc., Farmington, N. Mex.	126,912

Construction and Material for Which Bids Will Be Requested Through June 1956[1]

Project	Description of work or material
Central Valley, Calif.	Earthwork and structures for about 5.5 miles of 12- to 24-inch reinforced precast concrete pipe for Contra Costa Distribution System laterals. Near Antioch.
Collbran, Colo.	Constructing the 144-foot-high Vega earth dam and appurtenant structures, and relocating about 5 miles of county road. About 10 miles east of Collbran.
Columbia Basin, Wash.	Earthwork and structures for about 29 miles of laterals and wasteways, and constructing 3 small pumping plants. Block 46. Between Warden and Othello.
Do	Constructing 14 earth dikes, 12 with baffled apron spillways and 2 with precast concrete pipe outlets; and constructing a 60-inch double-barrel corrugated metal pipe road crossing. EL68D Wasteway. Near Othello.
Do	Earthwork and structures for about 15 miles of 245- to 3-c. f. s. capacity unlined laterals and wasteways with 16- to 2-foot bottom widths. Block 18. Near Connell.
Do	Constructing 2 outdoor-type pumping plants with 78 c. f. s. total capacity. Near Burbank.
Do	Constructing the 197-c. f. s. capacity Frenchman Springs Pumping Plant. Near Vantage.
Do	8 motor-driven, horizontal, centrifugal-type pumping units, 2 units each with a capacity of 33.5 c. f. s. at a total head of 57 feet, 2 units each with a capacity of 24 c. f. s. at a total head of 131 feet, and 4 units each with a capacity of 20.5 c. f. s. at a total head of 264 feet. Frenchman Springs Pumping Plant.
Ingalls Pumping, Kansas.	Drilling, casing, and pump testing 2 14-inch wells about 180 feet deep and drilling and casing 8 1¼-inch observation wells about 180 feet deep. Along the Arkansas River between Pierceville and Cimarron.
Michaud Flats, Idaho.	Drilling and casing 7 24-inch water-supply wells, 300 to 350 feet deep. Contractor to furnish all materials except well screen and gravel for packing. Area 6. Near American Falls.
Middle Rio Grande, N. Mex.	Clearing and excavating for conveyance channel and constructing metal jetties. On Rio Grande River, near Socorro.
Minidoka, Idaho	Earthwork, including stilling pools, and structures for 15- to 2.5 c. f. s. capacity laterals and sublaterals with 3- to 2-foot bottom widths. Group 7, Unit B, North Side Pumping Division. Northeast of Rupert.
Do	Earthwork and structures for laterals from Group 6, Unit B, North Side Pumping Division. West and northwest of Paul.
Do	Constructing 25 pumping substations, installing 32 deep-well pumping units and miscellaneous completion work. Group 4 Wells, Unit B, North Side Pumping Division. Near Rupert.
MRB, Nebraska	Earthwork and structures for about 19 miles of unlined canals, 3 miles of wasteways, 24 miles of laterals and 10.5 miles of drainage channels and appurtenant structures. Sargent Canal. Near Sargent.
Do	Earthwork and structures for about 5 miles of 250-c. f. s. capacity canal and for about 9 miles of 15- to 6-c. f. s. capacity open laterals. Upper Meeker Main Canal. Near McCook.
MRB, North Dakota.	Constructing the Grand Forks Substation will include grading and fencing the site, constructing concrete footings and a concrete block control building, steel structures, and installing a 115/69-kv., 50,000-kv.-a, 3-phase autotransformer and a 10,000-kv.-a. static capacitor bank, and associated electrical equipment, major items of which will be Government furnished. Near Grand Forks.
MRB, North Dakota.	Constructing buildings, power lines, telephone lines and erecting antenna towers for radio communication facilities in several areas of North Dakota.
MRB, South Dakota.	Constructing facilities for radio communication system including 15 10- by 12-foot prefabricated metal buildings, sixteen 200-foot radio towers with antennas, cable and lights, underground audio telephone and control lines between buildings and underground power cable. In or near following towns: Wasta, Clark, Ree Heights, Midland, Arlington, Pierre, Gettysburg, Burke, and Gary.
MRB, Wyoming	Excavating a 16- by 16.5-foot tunnel 1,700 feet long for Fremont Canyon Power Plant access road. 40 miles southwest of Casper.
Do	Constructing 5 miles of road including a 140-foot truss bridge for access to Fremont Canyon Power Plant on North Platte River, 40 miles southwest of Casper.
Do	Relocating 4 miles and improving 2.3 miles of Wyoming State Highway U. S. 87, which will include construction of a 290-foot bridge. North of Glendo.
Palisades, Idaho	Clearing lands, including removal of fences and buildings along the Snake River, upstream from the Palisades Dam, 60 to 80 miles southeast of Idaho Falls.
Rogue River Basin, Oreg.	Constructing the 90-foot-high Howard Prairie earth dam and appurtenant structures. About 20 miles southeast of Medford. Constructing a 6-foot-diameter horseshoe tunnel about 4,100 feet long. Near Medford.
Do	Removing a metal flume and constructing a 60-inch precast concrete pipe siphon about 375 feet long, and removing a 48-inch woodstave pipe siphon and replacing it with a 57-inch precast concrete pipe siphon about 1,970 feet long. Medford Canal. Near Medford.
Santa Maria, Calif.	Constructing the 216-foot-high Vaquero earth dam and appurtenant structures, and about 4 miles of access road. About 12 miles northeast of Santa Maria.
Solano, Calif.	Constructing the gated reinforced concrete Putah Diversion Dam with earth embankment on the left abutment, canal headworks, and sluiceway. About 40 miles west of Sacramento.
Do	Earthwork and structures for about 12.8 miles of 10-foot bottom width unreinforced conceete lined canal. Putah South Canal. Near Vacaville.
Weber Basin, Utah.	1 vertical-shaft, hydraulic-driven synchronous generator, rated 1,475-kv.-a., 0.95 power factor, 2,400-volt, 3-phase, 60-cycle, 450-r. p. m. for Wanship Power Plant.
Do	2 vertical-shaft, hydraulic-driven synchronous generators, rated 1,790-kv.-a., 0.95 power factor, 2,400-volt, 3-phase, 60-cycle, 514-r. p. m. and 1 vertical, hydraulic-driven synchronous generator, rated 630-kv.-a., 0.95 power factor, 2,400-volt, 3-phase, 60-cycle, 900-r. p. m. for Gateway Power Plant.
Do	1 vertical-shaft, Francis-type turbine with a capacity of 2,000 hp. at an effective head of 115 feet; 1 gate-shaft, open-type governor for regulating speed of turbine; and 1 guard valve. Wanship Power Plant.
Yakima, Wash.	Constructing 4 miles of open laterals and structures and about 17 miles of 20- to 3-c. f. s. capacity concrete pipe. Division 4 and Amon Laterals. Near Kennewick.

[1] Subject to change.

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Water Outlook

Continued from page 53

last year's drought. Combined storage in Sevier River Reservoirs is one-third less than last year and only 40 percent of average. Central Utah streams have fair runoff prospects. Some deficiency can be expected there in supplying water demands during the summer, but the shortage will not become critical unless dry weather continues through spring months.

WASHINGTON—With exception of the Elwha River headwaters and the Olympic Peninsula, the greatest snow pack of record existed on the mountain watersheds of Washington on April 1. Several individual snow courses had a maximum water content of record a month ago. April mountain snowfall increased the pack to a point where extremely heavy melt season flow is expected. Forecasts of seasonal flow range from 120 percent of normal for Mill Creek, near Walla Walla, to 190 percent of normal on Ahtanum Creek, a tributary of the Yakima River. For instance, Cayuse Pass snow course, on the headwaters of the Yakima and Cowlitz Rivers showed 329 inches of snow with 150 inches of water equivalent on March 29. This was among the many record measurements in Washington.

Over the State, irrigation reservoirs are filled to 56 percent of usable capacity and 85 percent of the 1938–52 normal. Franklin D. Roosevelt Lake, the major flood control reservoir on Columbia River, is at 80 percent of capacity and 101 percent of normal for April 1. Last year on April 1 this reservoir held 15 percent of capacity.

WYOMING—The snow pack in southern Wyoming decreased considerably during March in respect to normal, but remains 10 percent above the April 1 normal on the North Platte. Outlook for the North Platte and Laramie Rivers is above normal and much improved over the past 2 years. Water supply prospects have improved in the north and northwest mountains. Extremely heavy seasonal flows are expected for the Upper Snake River. Well above normal flows are expected for the adjacent basins of the Green River, Big Horn River, and on the Upper Missouri River tributaries.

Over the State as a whole, 1,500,000 acre-feet are in reservoir storage for irrigation out of a usable capacity of 4,500,000 acre-feet. This is 70 percent of the average April 1 storage. Mountain soil moisture throughout the State is well above normal. Less snow water will be needed to bring the soil to field capacity.

The prospects for most irrigated areas of Wyoming are good to excellent for the water year. # # #

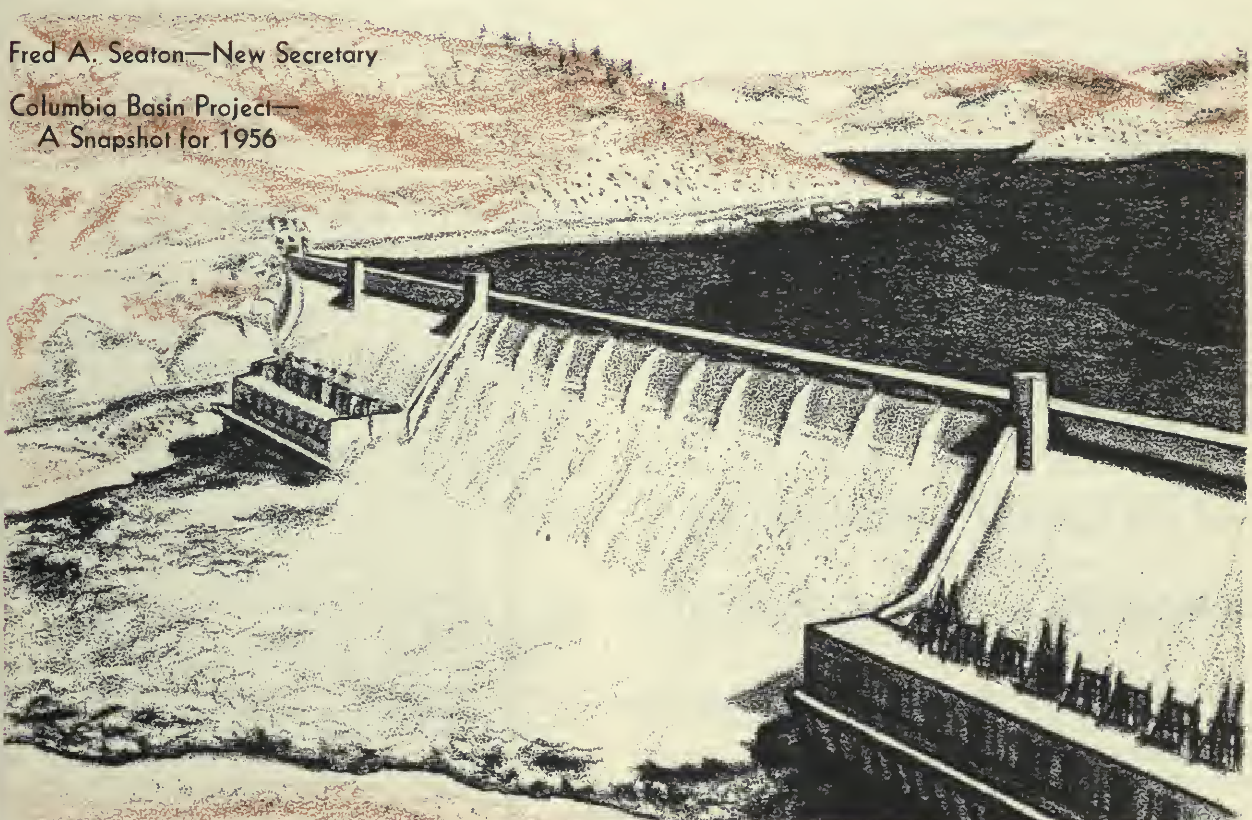
The Reclamation Era

August 1956

IN THIS ISSUE:

Fred A. Seaton—New Secretary

Columbia Basin Project—
A Snapshot for 1956



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In this issue . . .

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* * *

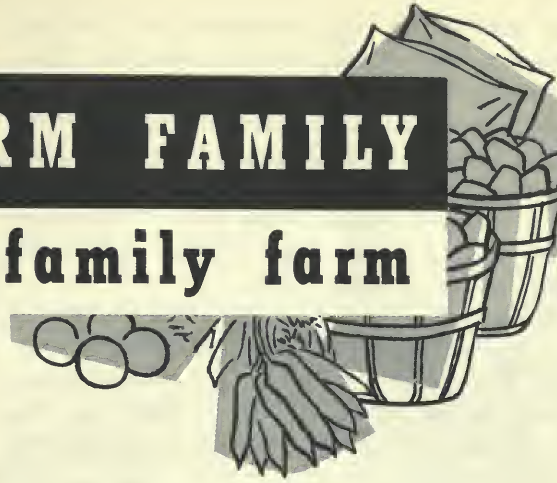
30 Years Ago in the Era

ORGANIZED RURAL COMMUNITIES

The foundation of reclamation, both in the West and the South, should be organized rural communities, with a definite agricultural program, and organized so as to cooperate in social and business affairs, in order that a community may function as a unit rather than as a number of isolated individuals. The absence of any sense of permanence, of a properly trained body of farmers, and of any kind of business organization all tend to make the farmer inefficient, place him at a disadvantage with the organized industries of cities, and are leading to a continuous depletion of soil fertility and decadence in the quality of the rural population. If we could create the right type of community, animated by the right ideals, on these unpeopled or neglected lands, we would set an example that might have far-reaching results.

Dr. Elwood Mead
Commissioner of Reclamation

FARM FAMILY on family farm



Editor's Note: We are indebted to Mr. Dwight K. Parks, publisher of the Southwest Rancher for the following article and photographs which appeared in the February 1956 issue of the Rancher.

THE WALTER WHITE FAMILY—BACK ROW: Dick, Walter (holding Colleen), Dorothy (holding Tommy Joe). FRONT ROW: Betty Jo, Diana, Jacqueline Ann (Bill, 15, absent from picture).

When Congress legislated the Bureau of Reclamation into existence as the Federal agency for speeding up development of the arid and semiarid regions of the west through irrigation projects and administration of Homestead Act provisions, it specified in the legislation that such assistance was intended for establishment of all farm-family land settlement. What the legislators probably had in mind were families like the Walter White family of the Wellton-Mohawk Division of the Gila project near Roll, Ariz.

Forty-six year old Walter White, his wife, Dorothy, and seven children are transplants from the Riverton, Wyo., project. Now establishing themselves on their 160 acres west of the town of Roll, they represent the real cooperative family spirit which would make the founders of the Homestead Act proud of their action.

Walter White was born and raised on a Clinton County, Iowa, corn and hog farm but like many other boys of farm birth was anxious to leave home on the farm and seek his fortune elsewhere. He was so eager that he even left high school to get started on what was to be a fast-dollar-early-retirement success story. His quest took him from job to job and from place to place and involved such things as an unskilled youth might find. He was a laborer on construction jobs, painter, cook, truck driver, cooking ware salesman and subsequently a jelly maker and a truck-owner with contract hauls of agricultural limestone.

Married in 1938, the White family was started by the time World War II came on but Walter put in over 2 years service in the South Pacific as a Sea Bee. The postwar period was the period when Walter invested in his trucking business and both business and family grew. Now mature and of better judgment, Walter realized that farming, in spite of its demands, was a highly desirable occupation for real independence and most suitable for raising a family.

Having his mind made up to return to farming, he immediately filed application for a homestead when the news broke in the papers concerning land to be had in the Riverton, Wyo. project under the drawing and qualification procedure. He drew a 160-acre unit and met the reviewing board's requirements, so he sold his business and the family moved to their western ranch.

Walter later discovered that he had drawn one of the less desirable units under which shale and limestone were responsible for returning alkaline salts to the ground surface and land so tight that

water penetration was maximum at 6 inches. Legislation was enacted for the relief of those homesteaders so affected, legislation still controversial in some quarters but making it possible for an exchange of Riverton homestead rights for land in newer and more suitable Bureau projects. Thus it was that Walter chose Roll. Some other projects were available, but the Wellton-Mohawk looked best for farming to him.

He says the living conditions and climate in Wyoming were excellent and but for the soil condition they would gladly have remained there. Getting started again isn't easy either, but the prospects here, he knows exceed all possibilities of the Riverton acreage.

When Walter tossed his name in for the Roll drawing he wound up 21st in the 28 parcels but because of others who withdrew or were eliminated, he managed to advance up to number 10 for choice of unit. His selection was made on the basis of soil classification and location. About 140 acres of this homestead is class 1, the balance class 2 and 3.

The raw land was cleared of brush in about 3 months, dozers doing all the heavier work, the lighter clearing and burning a family project. Leveling is now in process under contract. Eighty-five acres of the new land has been seeded with Ramona 44 wheat. Four acres back of the residence is in oats and barely for the family cow and doing well.

The two older boys (Dick, 17 and Bill, 15) have been particularly helpful in preparing and planting. They and the rest of the family like living and working on the farm and they will make it possible to operate this farm as a family unit.

The price incentives will decide plantings to a large degree, although the growing program will also be set with other factors considered. Walter likes the idea of milo and soybeans to go in following the wheat because soybeans, especially, are good for the conditioning of soil. He has begun a limited testing with fertilizer but says chemical laboratory analysis and harvest of the first crop will better show what fertilization needs may be.

The ease of local irrigation is one of the wonders to White. Riverton's land irrigation, he says, was a continuous summer job because of switching water from terrace to terrace. He's learned a great deal about irrigation in these parts, we presume, since he is working as a ditch rider for the W-M Irrigation District until his place gets into full production. This job is not just a job to Walter for, besides the importance of feeding his family, it's an opportunity to observe practices of growing which he may adopt or reject in his own program.

The Whites arrived from Wyoming 15 months ago in company with another homestead family. Together they had chartered a freight car to haul all the farm equipment and major household items and then drove down towing the housetrailers that became homes once they reached the homesteads at Roll. The Whites overflowed even their big trailer and so a couple of the children slept in

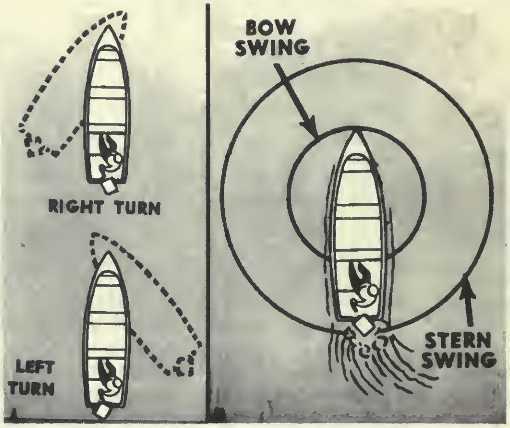
(Continued on page 76)

DICK WHITE is pictured on tractor where he spends much of his time when not in school. Help like this can't be hired. **AT RIGHT** is the White home with auxiliary sleeping quarters (house trailer) and showing sacks of wheat seed stacked on porch.

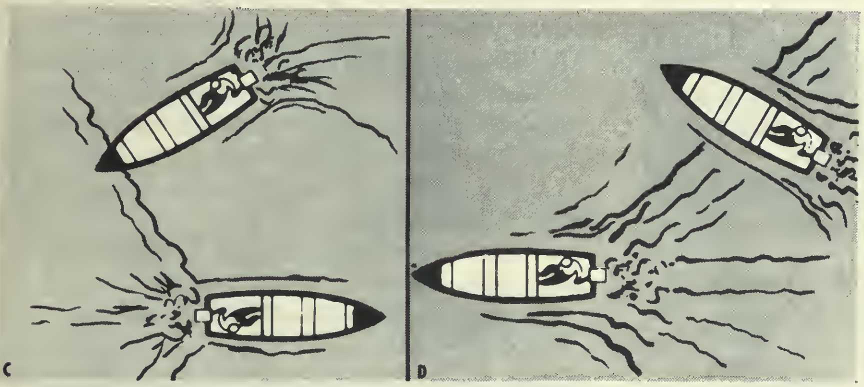
Lifesaving Requirements for Amateur Cruisers

by HARRY J. FEY, Assistant to the Director of Public Relations, Outboard Boating Club of America, Chicago, Illinois

ALL ILLUSTRATIONS COURTESY OF THE OUTBOARD BOATING CLUB OF AMERICA



MANEUVERING THE BOAT. The basic maneuver of movement—turning—affects a boat quite differently than a wheeled vehicle. In a boat, the steering is done by pushing the stern to one side, with the bow pivoting around a smaller circle. Diagram A shows the action of bow and stern when turning. In Diagram B the same action is exaggerated as the boat turns clockwise in a complete circle.



C. PASSING. Keep your eye on the wake of the boat you are passing as well as the boat itself.

D. OVERTAKING. The accepted Traffic rule is to overtake on either the right or left, remembering that the boat being overtaken has the right-of-way.

With their outboard-powered boats trailing behind their family cars, hundreds of thousands of boaters are flocking to the lakes created by the various reclamation projects in the West.

These great expanses of water have a twofold attraction to boaters; they offer excellent fishing, and they provide scenery that forms a beautiful backdrop to carefree days of family cruising:

The fun and thrill of boating has caught the fancy of the American family in a manner unduplicated since "Mahjong" was the rage. Boating not only takes the family into the outdoors where they can soak up a bit of sunshine and fresh air, but boating is a safe sport, one in which the entire family can take part without fear of accident if a few basic rules are followed.

For the benefit of boaters who might forget to equip their craft with the proper safety equipment, the U. S. Coast Guard, in charge of all Federal waters, requires that boaters carry the following bits of gear for their own protection.

If a boat is under 16 feet in length, the only requirement is that the boat be provided with a life jacket or other form of lifesaving device for each person aboard.

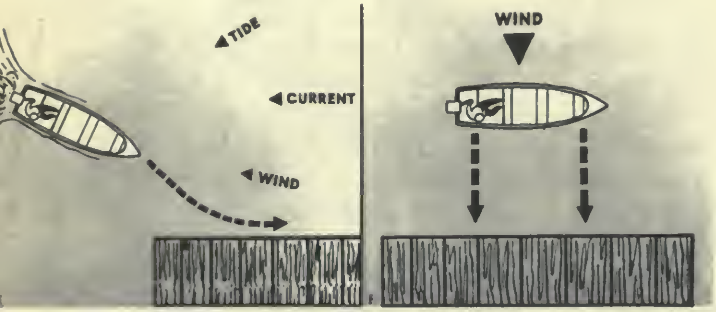
Boats in excess of 16 feet and less than 26 feet must have the life jackets, plus—one combination bow light, showing green to starboard and red to port (visible 1 mile), 1 white light aft showing all around the horizon (visible 2 miles), 1 whistle or horn (audible for one-half mile). Larger boats require slightly more elaborate safety gear and running lights.

Aside from the equipment, the boater need only

have an average amount of common sense to get along famously on the water.

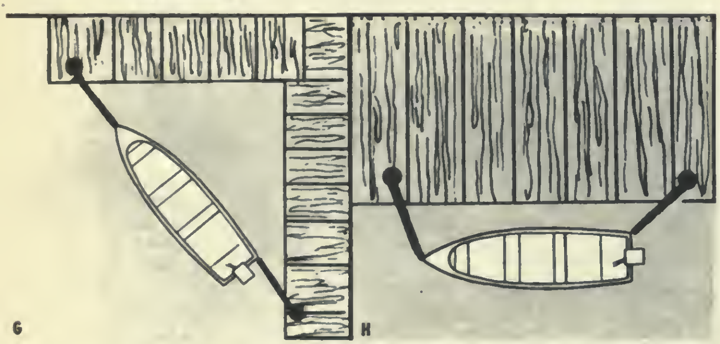
The rules of safety are not complicated. They are only an aquatic application of common sense.

A good place to start exercising common sense is getting aboard. Step aboard as nearly to center as possible, keeping low.



E. The proper side to approach is against the combined forces of wind, current, and tide, whichever is strongest. On a lake, this is usually the lee side (against the wind).

F. If you must come in with the wind, tide, or current, point for a landing several feet out. Cut throttle and drift sideways into the landing.



G. TEMPORARY OR PERMANENT: Boat at an angle across T or L shape dock.

H. TEMPORARY: Tie up on lee side using bow line only, or bow and stern lines as shown.

Installing the outboard motor should be as easy as possible. The simplest way for one man to get the task done is to place the motor on the dock, step into the boat and then, with feet firmly braced, reach up to the dock and take hold of the motor. Place the powerplant on the transom, and tighten the stern bracket screws securely by hand. For added safety, use a chain or stout rope to secure the motor to the boat.

An impartial study of boating mishaps reveals that in nearly every case the real cause turned out to be 1 of these 3: too many people in the boat, failure to keep a sharp outlook, speeding at the wrong time or the wrong place.

Fortunately, these three "ailments" respond quickly to a dose of common sense.

Remembering these common sense pointers will add hours and even years to the family's fun afloat:

Don't overload the boat. Look for and heed the weight limit plate.

Don't overpower the boat. The plate that shows the load capacity will also tell the horsepower limit.

Don't show off. Don't go out in bad weather.

Always carry a bouyant cushion or life jacket for each passenger and make sure that each child aboard is *wearing* a life jacket at all times.

Common sense should keep boaters from overturning the craft. However, if the boat does tip, don't swim for shore. STAY WITH THE BOAT.

To prevent accidents on the waterways, five simple "rules of the road" have been established. They are:

1. Boats without motors have the right of way over outboards.

2. Keep to the right of narrow channels or canals.

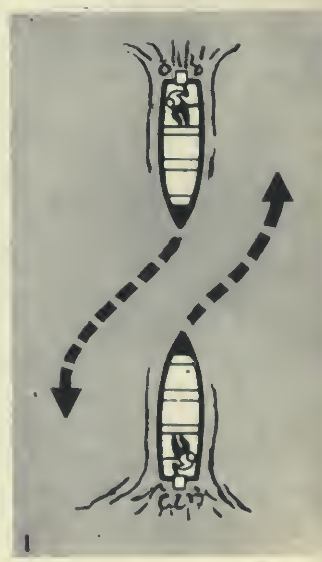
3. When approaching another boat at an angle, the boat that is to the right has the right of way. (Don't try proving your right with a steamboat or barge tow, they're just too big!)

4. When meeting another boat head-on or nearly so, swing to the right.

5. When overtaking another boat, the boat being overtaken has the right of way.

The Outboard Boating Club of America offers a one-book course in safe boat handling. The booklet is available free upon request to OBC, 307 North Michigan Avenue, Chicago 1, Ill.

I. PASSING ANOTHER BOAT: When meeting head-on, each boat swings right, then straightens out on the original course.



COOPERATION TO THE RESCUE

the Story of the Newlands Project Earthquakes

by GEORGE P. SOUTH, Chief
Operations and Drainage Branch
Region 4, Bureau of Reclamation

DISASTER, ACTION, SUCCESS; disaster, action, success!

Those words briefly describe the incident of the Newlands project earthquakes that struck western Nevada on July 6 and August 23, 1954, with such intensity that many irrigation and drainage facilities were seriously damaged, made inoperative, or destroyed to the extent that 80 percent of the project lands were without water. Since 1860, Nevada has had many shocks of varying intensities.

Beginning with the quake at 4:15 a. m. on July 6 there were 86 shocks by September 9, 1954, with intensities ranging from 4.0 (Richter scale) to 6.8. The first shock and that at 10:51 p. m., August 23, reached an intensity of 6.8.

The major constructed features of the project consist of the Lahontan and Lake Tahoe Dams, the Carson River and Derby Diversions Dams, 608 miles of canals and laterals, and 350 miles of drains. Other facilities include powerlines, diversion dams, culverts, bridges, and water control and conveyance structures to serve an area of about 70,000 acres of land under water right contracts in the vicinity of Fallon, Nev.

Damage from the July 6 earthquake resulted in many localities of the Newlands project, ranging from slight cracking in the lining of the Truckee Canal tunnels, about 30 miles west of Fallon, to extensive damage to the canal and drainage systems of the project, particularly in the Lone Tree and Stillwater areas located approximately 6 miles south and 10 miles east, respectively, of Fallon. The largest individual structure seriously damaged was the Coleman Diversion Dam located approximately one mile northwest of Fallon. This structure failed because of displacement and crack-

Typical longitudinal cracking and settlement of canal banks. Tractor bogged down trying to get around area. Stillwater region.

Settlement of Highway U. S. 50 east of Fallon. Line of block settlement extended considerable distance on both sides of highway.

ing of the earth-fill abutments of the dam, which in turn permitted water to erode around the structure itself, causing it to partially overturn, crack, and settle.

Numerous redwood box-type culverts, partially or completely collapsed. Most of these were located along drainage channels and at points where roads or irrigation ditches crossed the drains. Longitudinal cracking and sloughing occurred in many places along both drainage channels and irrigation canal banks.

In the Lone Tree and Stillwater areas canal banks settled from 1 to 3 feet and at the same time the bottoms of the canals were raised from 1 to 2 feet, and in an extreme case, the bottom of a drain ditch was forced up 5 to 6 feet, by the heaving action of the quakes.

The electrical system of the Truckee-Carson Irrigation District[1] suffered damage amounting to approximately $4,000, principally in transmission lines; some connections were broken and displacement of the ground and poles caused excessive sag in the lines.

The Stillwater Wildlife Management Area, located about 15 miles north of Fallon, sustained damage to its shops and to the East Side Canal serving some marsh and pasture areas.

There was considerable damage done to the business district of Fallon, as well as private residences throughout the entire project area, in the form of cracked walls, foundations, and falling cornices and chimneys on roofs.

Some private wells and water systems were made inoperative beyond repair and an undetermined acreage of the ranches in the project area suffered considerably due to heaving of the soil. In numerous instances large sand boils were formed by water erupting from cracks and fissures that appeared in lawns, cultivated farm ground, roads, and native brush land. In some localities considerable acreages of farm land will have to be leveled because of the undulating surface made by the quakes.

Longitudinal cracks, undulations in the paved surfaces having a differential in elevation of from 6 inches to 2 feet appeared on highways and roads. In one instance, at a point 23 miles east of Fallon, highway U. S. 50 settled about 2 feet.

Mr. Phil Hiibel, Manager, Truckee-Carson Irrigation District, explained the damage to project works as follows in a paper given before the Eighth Nevada Water Conference on September 30, 1954:

"The sights we saw were, to say the least, appalling. There were stretches of irrigation canals where the banks had broken up and sunk from 2 to 3 feet. In all such cases, the banks and adjacent ground were flooded and softened. In some instances the bottom had heaved upwards as much as 2 feet. One section of ditch some 600 feet long was obliterated. Concrete control structures were knocked awry, a few cracked and broken. Several small concrete structures had sunk 1 to 2½ feet. A sixty foot section of metal flume had collapsed. Three other flumes were damaged. A few timber structures had literally popped out of the ground. Sections of drains had sloughed in, heaved up in the bottom or had been closed altogether by lateral movement of the adjoining ground. Several timber culverts had collapsed. The Stillwater Slough, which serves as the trunk drain for about twenty percent of the district lands had sloughed in intermittently over eighty percent of its length."

Immediate action was taken by the district and the Bureau of Reclamation to ascertain the extent of damage by inspection of the project works. The Lahontan Dam on the Carson River, forming a reservoir of 290,900 acre-feet, was found to have suffered no appreciable damage; the Carson River Diversion Dam on the Carson River located about ten miles west of Fallon was unaffected; the Coleman Diversion Dam, located about 1 mile northwest of Fallon, had failed and would have to be replaced; and the earth-fill Sagouspe Dam

[1] The care, operation, and maintenance of project facilities were assumed by the Truckee-Carson Irrigation District on December 31, 1926, under terms of the Government-District contract of December 18, 1926.

5 miles north of Fallon, had settled about a foot but the damage was not serious.

At the board of directors' meeting on July 7 Mr. Hiibel advised the board of the grave situation the water users were facing. He pointed out that there were thousands of acres of farm land to which the district was unable to furnish water. This was the beginning of the warmest part of the summer. The second crop of alfalfa and the winter wheat needed irrigation. The Coleman Dam and the irrigation canals had to be repaired immediately, and thereafter the drains would have to be opened. All this had to be done quickly to avoid serious crop damage.

Since the district operates on an annual budget and does not have ready money to meet such conditions as earthquake disasters, it made an appeal to the Governor of the State of Nevada for assistance. The governor recommended that the area be classified as a disaster area and the information was forwarded to Washington with an appeal to President Eisenhower for Federal assistance.

On July 14, 1954, the President determined the damages in those areas of the State of Nevada adversely affected by the earthquake to be of sufficient severity and magnitude to warrant disaster assistance by the Federal Government to supplement State and local efforts. Such assistance was rendered under the authority of Public Law 875, 81st Congress, as amended.

An excellent spirit of cooperation was shown by all interested individuals and agencies, including the water users, the district, local governments, Bureau of Reclamation, Department of the Interior, Federal Civil Defense Administration, Bureau of Indian Affairs, and Department of Navy. The district's equipment was immediately put to work. Equipment owned by local water users, local and Federal government agencies, and local contractors also aided in making repairs and replacements. By July 16 there were 53 pieces of heavy construction equipment working on the project to restore water service.

Funds were made available from the Bureau of Reclamation Emergency Fund to finance the costs of the emergency repairs and temporary replacements. The district board of directors unanimously passed a resolution on July 17, 1954, to the effect that the district would repay all appropriate expenditures made from Reclamation funds advanced for the emergency repair of earthquake damages to the Newlands project, which could not be reimbursed from other funds.

Irrigation service had been restored to all lands when the intense quake of August 23 struck the project. The rehabilitation of facilities carried on during the previous six weeks was completely obliterated in some locations. The type of destruction was the same as that resulting from the July 6 quake. There was some damage to buildings at Lovelock, Nev., and one dam abutment collapsed on the Humboldt project.

The district took immediate action to restore water service to the project lands and through the use of its own and privately owned equipment started rehabilitation work on August 24 and by September 1 facilities were available to about eighty percent of the project area.

The August 23 quake did not present a threat as severe as that of July 6. A good portion of the farmland had been irrigated and the weather had turned cooler.

Additional Bureau of Reclamation funds were made available for meeting costs incurred in making emergency repairs and temporary replacements. The board of directors of the district passed a resolution on August 27 similar to that of July 17. On August 27 the President stated that his original determination of July 14 of a "major disaster" in the areas adversely affected by the earlier earthquake was sufficiently broad to permit continued assistance.

The Federal Civil Defense Administration is charged with carrying out the provisions of Public Law 875 and in this capacity was very active during the Newlands project's earthquake dis-

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COLEMAN DIVERSION DAM—One Mile Northwest of Fallon.

389589 O—56——2

FRED A. SEATON, Hastings, Nebr., Deputy Assistant to President Eisenhower, takes the oath of office as the 36th Secretary of the Interior at the White House on June 8, 1956. Sherman Adams, Presidential assistant, watches as Bernard M. Shanley, appointment secretary to the President, administers the oath. Christine, 13, looks on as her father takes the oath. *Photo by Abbie Rowe. Courtesy of National Park Service.*

Fred A. Seaton

SECRETARY OF THE INTERIOR

Fred A. Seaton, who became Secretary of the Interior on June 8, was serving as Deputy Assistant to President Eisenhower at the time of his appointment.

Mr. Seaton, a publisher of Hastings, Nebr., was born in Washington, D. C., December 11, 1909, son of Fay N. and Dorothea Seaton. He attended Manhattan, Kans., public schools and Kansas State College 1927–31. In 1931 he married Gladys Hope Dowd and they have four children: Donald Richard, 15, Johanna Christine, 13, Monica, 10, and Alfred 9.

Mr. Seaton was appointed to the United States Senate on December 10, 1951, to fill the vacancy caused by the death of Kenneth S. Wherry. He served as an adviser to President Eisenhower during the presidential campaign, June to November 1952.

Mr. Seaton was nominated as Assistant Secretary of Defense (Legislative and Public Affairs) on September 1, 1953, by President Eisenhower and sworn into office on September 15, 1953. He served as Assistant Secretary of Defense until his appointment as Administrative Assistant to the President on February 19, 1955, and Deputy Assistant to the President on June 15, 1955.

A successful businessman and administrator, Mr. Seaton is closely identified with not 1 but 5 of the 17 reclamation States, having publishing interests in Nebraska, Kansas, South Dakota, Wyoming, and Colorado. In this capacity he has participated actively in many phases of the de-

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PROTECTIVE COATINGS FOR STEEL WATER PIPES

by PAUL W. LEWIS
Head, Paint Laboratory Section
Engineering Laboratories
Denver, Colo.

HERE ARE 15-foot penstocks leading to Shasta Dam Powerplant. Penstock used in 1949–54 test is at far right. ***Photo by Ben Glaha, Region 2.***

From the Bureau's engineering laboratories in Denver comes news of the latest research efforts to curb the ravages of corrosion of steel water pipes on Reclamation's West-wide projects. The intensive laboratory work, carried out over a period of 10 years both in the laboratories and at field installations, demonstrates that a variety of coating materials shows promise of protecting steel pipes and substantially reducing the costly item of corrosion on the Bureau's operation and maintenance books.

What are these promising coating materials? They include red-lead phenolic and vinyl-resin paints, asbestos felt wrappings, synthetic rubber coatings, heavy wax coatings with a wrap, and plastic tapes wrapped around steel pipes.

The coatings, developed by the paint and plastics industries during and following World War II, were first subjected to a variety of rigorous laboratory screening tests and then exposed to additional severe tests in the field. The investigations also confirmed that certain time-tested materials, such as coal-tar enamels, retain their importance in the first line of defense against corrosion.

From 1 field test alone, during which 20 different coatings were exposed to sustained service conditions, 6 coatings continue to give excellent performance. This test was begun in 1949 at the Shasta powerplant on the Central Valley project in California. The 20 different coatings were applied to test sections on the interior of one of the five 15-foot diameter steel penstocks which carry water to the powerplant. For a period of 5 years the coatings were exposed to the full force of the torrent of water flowing through the pipe. At yearly intervals engineers entered the penstock, photographed the coatings, and evaluated the coating performance.

The Shasta penstock test showed that the coatings which best withstood the onslaught of the rushing water were 2 different types of phenolic paints, 2 types of red lead phenolic paints, coal-tar paint (classified by the Bureau as CA–50), and vinyl-resin paint. Phenolic and vinyl-resins are synthetic organic compounds which impart good durability when they are employed as basic constituents in paints.

In 1950, the research engineers applied 16 coatings to the interiors of several 30-inch diameter experimental steel pipe sections which were then transported to the Shadow Mountain Reservoir

on the Colorado-Big Thompson project in Colorado. Here the coated pipe sections were exposed for 4 years to the icy blasts of Rocky Mountain winters (when temperatures may reach as low as 40° below zero) and to submergence in the reservoir during the summer months. The results of these rugged tests showed that the following coatings were in excellent condition after the 5 years of exposure: Cold-applied asphalt paint, neoprene (synthetic rubber), cement mortar (of low water content), coal-tar paint CA–50, and vinyl-resin paint. A pheonolic red-lead coating applied to the pipe sections in 1954 so far shows excellent durability.

The Denver researchers' investigations also included laboratory tests on a variety of coatings placed around the exterior walls of pipes buried in specimens of clay soils. Some clay soils, found in many parts of the West, are not only corrosive, but they also rapidly destroy exterior coatings. As the soils dry after wetting, the contracting clay develops powerful stresses which disrupt the coatings by a shearing or tearing action. The behavior of the coatings was studied as the soils underwent repeated wetting and drying cycles which covered a period of about 1½ years of testing. The disruptive forces which followed shrinkage of the soils raised hob with many coatings tested, but several materials had the stamina to resist the soil stress.

Coatings of coal-tar enamel with a reinforcement of spun glass and an asbestos felt wrapping were especially effective. A heavy wax coating

SPECIMENS of steel pipe concrete with various protective coatings were tested for soil stress in this clay box of soil. Disruptive forces which followed shrinkage of the soil after repeated wetting and drying caused damage to some coatings.

Protective coating of coal tar enamel and felt wrapping on two buried steel penstocks at right. Whitewash is being applied to penstock to protect it from the sun until backfilling is completed.

and a gilsonite (a resinous mineral) base coating, both protected by a shielding wrap, resisted soil stress satisfactorily. Cement mortar coating also passed the laboratory tests. Vinyl-resin paint and phenolic-resin red-lead paint show considerable promise of resisting soil stress.

The laboratory studies showed that plastic tape wraps are useful in protecting the exteriors of steel pipes. These tapes are well-adapted to the coating of welded joints of steel pipe because they are easily applied and require inexpensive application equipment. Hot-applied coal-tar tapes can be molded over irregular surfaces, and those that are reinforced with a glass-fiber mat have adequate resistance to soil stress. On one Bureau project, a 2½-inch diameter buried steel pipe protected by a vinyl plastic tape wrapping was uncovered after 3 years of service. Both the pipe and tape were found to be in good condition.

To sum up the laboratory and field studies, the following coatings are effective in protecting steel water pipes for which the surfaces are thoroughly cleaned and the coatings are properly applied and of good quality.

Coal-tar enamel continues to be an excellent lining for the interior of steel water pipe. The enamel is also well suited for the exterior of buried steel pipe if it is adequately shielded against soil stress by a glass mat reinforcement of felt covering.

Cement mortar is effective in lining steel water pipe, provided the lining is not exposed to ex-

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MAINTENANCE

by H. SHIPLEY, Chief Engineer,
Salt River Valley Water Users Association, Phoenix, Ariz.

Maintenance contains three basic words, namely: MAIN, TEN and CENT. Now, MAIN, TEN refers to our main 10 maintenance problems that keep us busy throughout the year. CENT stands for just one little penny but by the end of the year amounts to $540,000 for maintenance. Our irrigation project contains 238,000 acres and is laced with approximately 1,200 miles of canals, laterals and waste ditches.

What are our MAIN TEN maintenance problems on our irrigation project in the Salt River Valley?

1. Cleaning of ditches, a never ending chore caused by the sluffing of the banks, settling out of the silt and sand carried down from run-off, reservoir and forebays.

2. Removal of moss or aquatic growth, truly a plague. Not only does this nuisance clog the transmission system but also the farmer's irrigation syphon tubes. This useless plant grows very luxuriously in our Valley of the Sun and grows wild with our clear warm underground pumped water.

3. Clearing the waterways of foreign material such as fallen limbs from trees that line some of our laterals, tumbleweeds that seem to rush for a drink after a windstorm and clippings and grass cutting from lot owners adjacent to the canals. I guess that's the reason you never see lawns planted along the canals in Venice.

4. The placing of the fill along eroded banks caused by turbulence below structures and the fluctuating water deliveries.

5. Removing old structures when operating conditions change or when replaced by modern ones.

6. Emergency repair of canal bank breaks caused by gopher holes or storm waters.

7. Trenching or shaping of banks and ditches in preparation of the installation of gunited lining or concrete slipform lining, or for the installation of precast pipe or most recently for the construction of monolithic cast-in-place patented concrete pipe. This is an important phase of maintenance in our effort to conserve water, and reduce maintenance cost.

GRADALL cleaning lined ditches on drainage project. ***All photos courtesy of the author.***

8. Weed control, a costly job that is maintained 7 months of the year.

9. Leveling or removal of the berm built up by continual cleaning. These built-up berm banks may be along laterals built in borrow elevated above the normal ground and from those ditches below the roadways.

10. Lastly, and very important, the construction of new irrigation facilities in conjunction with the Bureau of Reclamation's Rehabilitation program. The construction of these new structures is very vital in the maintenance of our irrigation project in keeping abreast of modern development of urban areas and super highways. These were once lanes along a water course for thirsty crops that conquered the harsh desert lands.

These MAIN TEN costly (CENT) tasks are accomplished by man, horses, and machines. Many machines such as dozers, graders, dredgers, loaders, dump trucks, draglines, carryalls, boom trucks, and fork lifts, and hand tools including shovels, mowers, rakes, hooks, and tampers.

Yes, many machines, but the most modern machine not listed above is the Gradall. This machine deserves a paragraph for itself because it is the most versatile piece of equipment on the project and the star performer in mine of the MAIN TEN and the most economical (CENT) to operate. We of the Salt River Valley Water

Gradall with 24" shoes excavating drainage ditches in Florida marsh.

Salt River Valley W. U. A. employees preparing ditches for gunite lining at 1/5 former cost with Gradall.

Users' Association are fortunate to have at our command seven of these do-it-all Gradalls.

The only operation where the popular Gradall cannot assist is in the oil spray operation to control weed growth. We wouldn't be surprised that with a broken hydraulic line, we could spray our Johnson grass too.

We are not advocating that the Gradall is the best piece of machinery for all irrigation projects. And we realize that some projects due to certain operating or terrain characteristics, may use other equipment to better advantage. But if it weren't for the Gradalls on our irrigation project, many more man hours and pieces of equipment would be used and our maintenance costs would be higher.

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WEEDS?

The good farmer keeps weeds off his land. He buys certified seed. He cleans planting and harvesting machines used on his farm. He avoids hay and livestock feeds grown in weedy areas. He also puts a weed seed screen below his turnout to stop water borne weed seeds.

* * * *

How fast do noxious weeds spread? Two patches of perennial sow thistle, about 1 square rod area, were the only known sources in one new irrigation area. Patches were about 2 miles apart. Two years later, there were at least 350 patches scattered over 400 farms in a swath 10 miles wide on the downwind side of the original infestations.

PROCESSING PLANT FOR HANDLING CROPS FROM NEW LANDS.

COLUMBIA BASIN PROJECT

A Snapshot for 1956

by P. R. NALDER, Project Manager
Columbia Basin Project, Washington

THE DREAMS OF MANY OLDTIMERS are coming true on the Columbia Basin Project located in the dry rain shadow of the Cascade Mountains in central Washington. Not often are those who dare to dream privileged to live to see the fruition of their continued efforts.

The Columbia Basin project was nearly 40 years in making the transition from dream to fact—but fact it is now, as green fields spread across the plateau surface, and the dust of progress rises from fields just newly cleared and plowed for seeding.

Settlement and development have crossed the threshold and are now in full swing. The beginning of the 1956 irrigation season brings water to a total of 3,979 farm units encompassing 301,402 irrigable acres.

The major structures are completed to serve the 600,000 irrigable acres by 1961. Lateral systems are built and an irrigation supply available to about one-half of this acreage this year. The ultimate development of the 1,029,000 acres must await the availability of lands on the eastern margin of the project area, on the Wahluke Slope, and in other scattered locations.

Here is a roundup on the project facilities as now completed. Grand Coulee Dam, the key structure, was completed in 1941. The last of the 18 world's largest generators went "on the line" in 1951—far in advance of the fondest hopes of most early optimists. Now, six huge irrigation pumps in the pumping plant at Coulee Dam hoist irrigation water through 12-foot-diameter pipes up the canyon wall 280 feet. And, commercial power taken from the falling waters of the Columbia River at Grand Coulee Dam is now bringing in more than $1 million in revenue per month. Water users will pay a little more than $1 million in water charges this year.

Waters pumped from the Columbia River have filled the Equalizing Reservoir brim full for the first time this winter. A total of 762,000 acre-feet of water stored within the walls of the upper Grand Coulee in the 27-mile stretch between North Dam and Dry Falls Dam at the opening of the 1956 irrigation season.

The 13,200 cubic-foot-per-second Main Canal and the West and East Low Canals—with all their remarkable tunnels, siphons, wasteways, and the like—are built and functioning nicely. So, too, is the Potholes East Canal which leads to the southern end of the project area from O'Sullivan

GRAND COULEE DAM, the engineers' town in foregr
Grand Coulee Dam and powerplant in background.
by W. H. Fuller, Region 1.

Below left: POTHOLES E
chute and stilling
Top right: Ephrata
Stan Rasmussen, b

Dam, named after the late Jim O'Sullivan, the resourceful dreamer who worked so long and hard for the Columbia Basin project until his death in 1948.

The Potholes Reservoir behind O'Sullivan Dam was filled this spring to its highest elevation yet—and nearly to its maximum level—by heavy snow melt runoff from its drainage basin. The 270,000 acre feet of active storage in the Potholes Reservoir, combined with the 762,000 acre feet in the Equalizing Reservoir, provided 1,032,000 acre feet of water for the opening of the 1956 irrigation season!

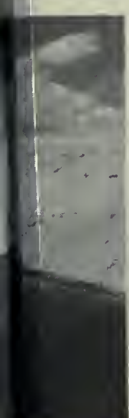
Construction on the Columbia Basin project now centers primarily on the building of lateral systems to convey irrigation water from the large canals to the project farm units. Lateral systems are completed for 4 to 5 irrigation blocks each year. Thus, irrigation water will be available for 35,000 to 45,000 acres of additional irrigable land each year until 1961.

At the present time, there are about 275 miles of canals in service and 1,180 miles of laterals. A tour along all the ditchbanks of the canals and laterals on the Columbia Basin project would be equivalent to taking a trip by auto from Denver, Colo., to Los Angeles, Calif.; and when you arrived there, you would still have nearly 200 miles left for sightseeing in that west coast metropolis.

Two important construction jobs remain to be undertaken in building the irrigation system for the 600,000 acre program. One is the Royal Branch of the West Canal, which will serve the western half of the Royal Slope. The West Canal is already built to serve the eastern half of the Royal Slope, and two irrigation blocks in that area received water for the first time this year. The Royal Slope is a 100,000 acre plus area reached by the last section of the West Canal after it passes through the 9,280 foot Frenchman Hills Tunnel. Prior to 1953, when the Bureau of Reclamation established its Royal Camp on the Royal Slope, there was only one permanent inhibitant in that area. As this is written in May 1956, there are already 60 farm units under development; probably some 120 of the 315 farm units for which water is available this year on the Royal Slope will be under development by the end of the 1956 irrigation season.

The second large construction job to be undertaken this year is the Wahluke Siphon. It will be about 3 miles long and carry irrigation water from the Potholes East Canal across a broad channel to the Wahluke Branch Canal on the Wahluke Slope. The Wahluke Slope, which extends from the Saddle Mountains to the Columbia River, embraces about 250,000 acres. However, a large portion of the Wahluke Slope is presently restricted for irrigation development because of proximity to the Atomic Energy Commission in-

econd section. Center: EAST LOW CANAL—Rocky Coulee wasteway Aerial view of irrigation blocks 86 and 87, Columbia Basin project. ed out in Xmas lights. *First photo by J. D. Roderick. Last three by* l.



RELIC OF BYGONE HOMESTEAD DAYS above. Top right: Garage building being built by Norman E. Parmeter in 1951 to serve as temporary residence. At right: We see the development that has taken place since on the Parmeter farm. *Top right photo by E. E. Shorthill. Right photo by J. D. Roderick, Region 1.*

stallation at Hanford, Wash. The Wahluke Siphon will be in part reinforced concrete with steel liner, in part reinforced concrete without liner, and in part welded steel pipe on piers.

Crop returns are in for the 1955 irrigation season. It was a tough year for the new farmers on the Columbia Basin project. Per acre gross returns were down about $42 as compared with 1954—$113.66 for 1955 as compared with $155.79 in 1954. The 1955 gross return for all crops raised on the project was $16,961,000.

Two factors accounted for this drop in gross crop returns. The onslaught of an unseasonably early freeze in the forepart of November followed by continued very cold weather seriously affected the harvest of beans, potatoes, and sugar beets. Conservative estimates of losses from this early freeze run from 1 to 1½ million dollars. The second factor was the decline in farm prices; farm prices slid down about 7 percent from December 1954 to December 1955. Even so, the gross returns per acre exceeded most of those obtained on other Pacific Northwest irrigation projects.

In 1955, a total of 149,572 acres were in crops, out of the 246,849 acres for which a water supply was available. Water was delivered to 2,480 farm units of which 2,408 were cropped. Water was available to a total of 3,331 farm units.

More than 50 different crops were successfully grown on the new farms on the project—con-

SPRINKLERS AT WORK below. Alfalfa is a good crop under sprinkler irrigation on these thin and sandy soils in Columbia Basin. CULTIVATING DRY BEANS bottom photo. Dry beans are an important cash crop on the project with good yields varying from 2,000 to 3,000 pounds per acre.

crete evidence of the wide adaptability of the lands and climate of the Columbia Basin project area.

The cropping pattern on the Columbia Basin project is that which is usually typical of the early years of the settlement and development of a new irrigation project. The major cash crops—dry beans, potatoes, peas, and sugar beets—comprise nearly 50 percent of the area cropped on the project; but under mature development, these crops will comprise only 15 percent of the cropped acreage, according to forecasts made by the agricultural specialists of the State College of Washington.

The acreage of cropped land devoted to alfalfa hay and other hay and pasture is increasing rapidly. In 1955, such crops accounted for only 23,388 acres or 16 percent of the cropped land, as compared to the State College forecast of 53 percent under maturity.

Wheat acreages seem large in the early years. Wheat and some other small grains are grown extensively as nurse crops, cover crops, and in rotation with row crops—very necessary and desirable practices in the first development years.

Although there was a wide variety of crops grown on the Columbia Basin project, the acreages of specialized crops were relatively small. This facts points directly to one of the greatest needs on the project, namely, the establishment of additional agricultural processing plants. Such plants are costly, and will not be built until the production on the new project farms is adequate to support the necessary investment by agricultural processors. On the other hand, the farmer is understandably reluctant to go heavily into the production of specialized crops until processing and marketing outlets are assured.

Pressures born of opportunities for the processors and needs of the new settlers are rapidly building up, and without doubt many needed processing plants will come into being soon. Even so, this year there were 49 agricultural processing plants in operation in the project; the equivalent of 570 full-time workers earned $2,250,000 in wages and salaries (exclusive of earnings of plant owners).

Settlement and development of the Columbia Basin project is proceeding successfully. It must do so, for the resource base is sound. That is, the combination of adequate amounts of cool, clear Columbia River water and the light but fertile desert soils create opportunities that men with industry in their makeups and faith in the future are quick to seize. The population of the area encompassed in the Columbia Basin project has risen from 11, 269 before World War II to an estimated 61,640 in 1955. Conservative estimates for 1960 indicate that the population will reach the 120,000 level by that year, or just about double the 1955 population! Completion of the 1,029,000 acre project will more than double that estimated 1960 population.

Such rapid growth of population, both on farms and in towns, has placed great demands on the local governmental agencies. They have met their responsibilities on an unprecedented scale. For example, 2 new State highways, 1 from north to south and another from east to west, are nearing completion. And, county roads are built by the time new settlers move onto their farms!

New schools are being built every year, as the numbers of children pyramid. Last year, one school district had more youngsters who were new enrollments than those carried over from the previous years.

Towns are providing the trade and professional services needed on an adequate scale; but the development of water and sewer systems, street and lighting improvements, and a host of other facilities are achieved only by the dint of exceptional efforts.

Successful settlement and development of the Columbia Basin project is being made possible, in large part, by the local people who are meeting their opportunities and responsibilities.

The vision and wisdom of the oldtimers, the engineers, and everyone else who has worked to make the Columbia Basin project a usable resource within the reach of individuals and large groups alike is paying off. The Bureau of Reclamation has reason to be proud of its role as a working partner in creation of the Columbia Basin project. # # #

YOUR MAGAZINE

Are there particular types of articles which you would like to see in the ERA that we have not printed to date? If so, please let us know, and we shall do our best to comply with your wishes.

WHAT TYPE of CATTLE GUARD?

by **R. J. WILLSON, Engineer**
Commissioner's Office
Denver, Colo.

DECK and SIDE GUARDS of this unit on the Provo River project, Utah, are constructed of 2-inch pipe. Side guards are of welded construction while the pit and deck frame are made of creosoted timber.

What type of cattle guard is best for your project? That was the question asked of the Bureau's operation and maintenance engineers in a survey recently completed by the Division of Irrigation Operations in Denver. Here, briefly, is a summary of the answers received from the engineers participating in the survey.

From the responses to the query, it's evident that there is considerable difference of opinion as to what constitutes good cattle guards, where they should be located, and how they should be constructed. However, all participants in the survey agree, that cattle guards serve a definite need for certain project areas and are particularly useful in expediting travel through stock-raising country.

Operation and maintenance engineers point out that the cattle guard selected should be the least costly one that will serve the needs of a particular location. The selection should also depend on the functional purpose of the guard; that is, the type and amount of traffic, the foundation material upon which it is constructed, the narrowness of the ditch banks, and similar considerations. On Reclamation projects in the southwest and south, selection of the proper type of guard must take into account the drifting sands that fill the pit under the guard—the roadway must be ramped up and over the guard to make cleaning of the pit simpler.

Low-cost cattle guards that have been successfully used on several projects include the "bedspring" (described in the March 1953 issue of the *Reclamation Era*) and the "spring-suspended" guards shown in the accompanying photographs. These two types have given satisfactory service in accommodating light traffic at low speeds and of limited weight. However, they have not been generally accepted for passing heavy equipment where the frequency of crossing the guards is high or where they must be crossed by tractors.

Other low-cost cattle guards available, such as the all-metal autogates manufactured by several commercial concerns, are in general use on some projects. They may be purchased in quantity at a saving and are relatively easily installed. Most of the manufacturers furnish several grades of guards depending upon the service to which they are to be exposed. Some of the more heavily constructed, commercially prefabricated structures have been installed on the Columbia Basin project. Reports indicate that cattle guards of this type are practical and maintenance is negligible if they are properly installed. Such guards may be installed on timber pits and foundations, although some engineers prefer a concrete foundation for added permanence and lower operation and maintenance costs.

The standard Bureau cattle guard is reported to be satisfactory by most projects on which the structure has been installed. It is constructed of timber and has 2½ inch pipe for deck rails, spaced at 7½ inch centers. The pipe is 10 feet 6 inches in length and provides for a clear deck

width of 9 feet 10½ inches between the bottom of the side guards. The principal objection to the present standard guard is that contractors' bids on constructing this design have been high.

From the standpoint of operation and maintenance, the standard timber and pipe cattle guard has been observed on one project to have a maximum useful life of about 10 years. After this period of use the timbers rot and eventually cause the deck to settle and fail. Treatment of the timber with wood preservatives will prolong the life of the structure, but the use of concrete and metal, as has been done in some replaced units on the Central Valley project in California, has provided longer life. Engineers on other projects have found that it is desirable to have concrete pits and foundations and metal side guards.

A cattle guard used on the Deschutes project is also constructed entirely of concrete and steel, and the deck and wing guards are constructed of 1-inch square steel bars. The post that holds the side guards in position, is of wooden construction.

The survey disclosed that in many locations cattle guards can be eliminated and that gates can be installed and maintained much more economically. The saving in construction, however, may be offset by the delays caused in moving

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ABOVE: Redwood posts have been installed to protect side guards on this standard structure on the Central Valley project in California. BELOW: "Spring-suspended" cattle guard constructed from air field landing mats on the Yakima project in Washington. Guides at base of side posts eliminate swing without obstructing floating action of the mat as car passes over it.

FARM FAMILY

(Continued from page 58)

their friends' trailer until the White's new home was completed last November.

The new house has only two bedrooms, but the sleeping problem was solved by use of the house-trailer. It makes an excellent arrangement and will serve nicely until an addition can be built onto the house. Proximity to a canal for a domestic

Domestic water storage used by Walter White is rectangular plastic bag weighing only 15 pounds empty. It is resistant to alkaline soil, heat, and earthquakes. The plastic cover strength is said great enough to prevent a falling through by even large adults. Pressure water system and automatic chlorination bring city convenience to Roil homestead.

water supply is convenient and White's system is worthy of rather detailed reporting.

The water is pumped from the canal into a cement-lined rock filter, flowing into the 6,000 gallon storage container by gravity. The storage item is the most unique we have seen and it may be the only one thus far in this region. The container is a vinyl plastic bag which weighs only 15 pounds unfilled, is resistent to heat, alkali, and is guaranteed indefinitely. The manufacturer claims no algae will form on water in the bag and its flexibility is positive insurance against damage by earthquakes. It may be emptied and removed for cleaning with little effort. To install the bag Walter simply dug a pit, framed the sides with redwood 1 by 12 planks and inserted it. There are steel rods sleeved into the upper edges which help hold its shape. It is 11 feet-8 inches wide, 15 feet-10 inches long and 5 feet deep. A cover of the same material is draped over to keep foreign particles out and is said to be strong enough to prevent adults from breaking through it. Here again the edges are sleeved for steel rods to hold the cover in place. Distribution is made by use of a pressure system. An automatic chlorination system feeds the proper amount of this purifying agent directly into the line but may be manually shut off when or if large quantities of water are wanted for washing or lawn sprinkling.

The Whites know they have much to do and sacrifices to make before their homestead will bring the rewards they want but they have experienced this situation before and are prepared for it. The example set by Walter is inspirational and might well guide the rest of us as well as his own family, for having lost a portion of his right arm in a combine accident while on the Riverton ranch he has not let that loss impair either his outlook on life nor his personal efficiency. Fitted with an artificial member, Walter has learned to manipulate it with finesse and without bitterness. A man that can triumph over such an experience need have no worry about making his way to financial success, especially when he has a fine family pulling with him. # # #

New Recreational Folder Available

A new recreational folder, entitled "Reclamation's Recreational Opportunities," has just been published by the Bureau.

The folder lists 140 reservoirs on Reclamation projects throughout the 17 Western States. It also contains information as to specific locations of these reservoirs, the name and location of the administering agency and specific facilities available; such as swimming, fishing, boating, hunting, camping, picnicking, and lodging. The folder also contains a map on which the name and location of each reservoir is indexed.

For copies write to your nearest Regional Director or the Assistant Commissioner and Chief Engineer's office at Denver. For addresses of these offices please consult the directory on the back cover of the *Era*.

Upper Colorado River Storage project—Artist's conception of GLEN CANYON DAM. *M. H. Willson, Artist.*

L. F. WYLIE
heads Glen Canyon Dam job

Secretary of the Interior Fred A. Seaton recently announced the selection of Assistant Regional Director L. F. Wylie of Amarillo, Tex., as construction engineer for Glen Canyon Dam on the Colorado River.

Mr. Wylie, who began his Bureau of Reclamation career in 1932 as an assistant engineer on Hoover Dam, was selected by Reclamation Commissioner W. A. Dexheimer. As Construction Engineer, Wylie will have primary on-the-job responsibility for the building of Glen Canyon Dam, a principal structure of the Colorado River Storage project.

The dam will be located on the Colorado River in Arizona about 8 miles south of the Utah State line. The dam will approach Hoover Dam in size and other physical characteristics and will serve additional river regulation, hydropower, and other multiple-purpose functions. It will be approximately 700-feet high and will create a reservoir with 26 million acre-feet capacity backing up a lake 186 miles upstream.

The dam site is in an isolated and arid section of the country in very rugged terrain and approximately 140 miles from the nearest railroad. Thus, one of Mr. Wylie's most immediate problems is the completion of access roads and the establishment of a construction town in the immediate vicinity of the dam site.

Mr. Wylie is a native of Jenny Lind, Ark., and graduated from the University of New Mexico with a B. S. degree in civil engineering. He was at Boulder City, Nev., for 3 years while construction of Hoover Dam was at its peak, then, in 1935, became associate engineer on the construction of the All American Canal in southern California. In 1940, he directed field surveys on the Gila Reclamation project in southwestern Arizona.

During World War II he served as company commander in the combat engineers with the Marines, returning to the Bureau as field engineer for the San Luis project in Colorado. Subsequently, he served in various responsible construction capacities with the Bureau, becoming Assistant Regional Director of the Amarillo, Tex., office in May 1955. #

COOPERATION

Continued from page 63

aster. Through that agency the Reclamation Emergency Fund was reimbursed from the President's Emergency Fund in the amount of $164,344, which relieved the district from repaying an equal amount to the Reclamation Fund in accordance with the resolutions passed by the district.

The extent of damage to facilities may be summarized as follows:

Feature	Unit	Extent of damage by: July 6 quake	Extent of damage by: August 23 quake
Canals (numerous)	Miles	7.6	8.1
Drains (numerous)	Miles	18.8	10.1
Culverts	Individual structures	19	12
Bridges (timber)	Individual structures	6	5
Flumes	Individual structures	2	2
Diversion Dams	Individual structures	2	1
Minor concrete structures, checks, drops, turnouts.	Individual structures	11	12

Detailed surveys of damages and estimates of cost of repairs were made by the Lahontan Basin Development Office of the Bureau of Reclamation. The cost of restoring facilities was estimated to be as follows:

Emergency repairs and temporary replacements:		
July 6 earthquake	$104,555	
August 23 earthquake	85,800	
Subtotal		$190,355
Additional work necessary to restore facilities to pre-earthquake conditions in addition to above		102,340
Total		292,695
Funds to meet costs of restoring facilities to pre-earthquake conditions were available or are to be obtained as follows:		
Emergency repairs and temporary replacements:		
Truckee-Carson Irrigation District	$26,011	
President's Emergency Fund under Public Law 875	164,344	
Subtotal		190,355
Additional work to be done by district as funds are available		102,340
Total		292,695

Mr. Hiibel, in his paper presented before the Eighth Nevada Water Conference, finished as follows:

"Emergency repair work has now been pretty well completed, and we are waiting for the completion of the irrigation season before beginning permanent repair work to canals and structures. With the quick response of all the Government agencies that came to our aid, we were able to avoid any serious loss of crops to this reclamation project. Without the timely help from the President on down, the damage to the crops and the resultant loss of feed for livestock in Nevada would indeed have been very great. On behalf of the Truckee-Carson Irrigation District, I wish to express our sincere thanks to all the people who helped us."

# # #

REPORTS ON THE ACCOMPLISHMENTS OF RECLAMATION

At the request of the Chairman of the House Interior and Insular Affairs Committee, Reclamation Commissioner W. A. Dexheimer has submitted to him reports setting forth the accomplishments on five Reclamation projects. These reports supplement general reclamation information submitted to the Committee in 1954 and published as "The Growth and Contribution of Federal Reclamation to an Expanding National Economy," Committee Print No. 27.

The projects selected and the titles of the reports are as follows: Central Valley—"The Contribution of Irrigation and the Central Valley project to the Economy of the Area and the Nation," North Platte—"A Report on the Accomplishments of Irrigation in the North Platte project area, Nebraska-Wyoming," Strawberry Valley—"Strawberry Valley project, Utah—Reclamation Accomplishments," All American Canal System, Boulder Canyon project—"Contribution of the All-American Canal System, Boulder Canyon project to the Economic Development of the Imperial and Coachella Valleys, California and the Nation," Columbia Basin—"Progress and Prospects, Columbia Basin project, Washington."

The first two of these reports have been printed by the committee and copies are available to the public. For the Central Valley and North Platte project reports you may write to your nearest Regional Director. For addresses consult the back cover of the *Era*.

The other three reports probably will be published in the near future. You will be advised in the *Era* when copies become available.

FRED A. SEATON

Continued from page 64

velopment of the resources of the plains, and for years has strongly supported every sound conservation cause.

In recent months, from his White House office, Secretary Seaton has been performing to a certain extent as a secretary of natural resources without portfolio, aiding in the coordination of the resources functions of the Departments of the Interior, Agriculture and Defense.

Mr. Seaton is trustee of Hastings College and University of Nebraska Foundation; awarded honorary degree, Doctor of Laws, Kansas State College, February 9, 1955; awarded honorary degree, Doctor of Humanities, Maryville College, Maryville, Tenn., November 5, 1955.

Member: Rotary, National Editorial Association, Inland Daily Press Association, Beta Theta Pi, Sigma Delta Chi, Pi Kappa Delta, Elks, Newcomen Society of America, and Knights of Ak-Sar-Ben. #

The Editor's Column

The following facts have been gleaned from the United States Department of Agriculture's "Agricultural Situation," dated May 1956. We hope that you find them helpful.

Although farmers' realized net income this year under present conditions may total somewhat under 1955, most, if not all, of the decline has already occurred. This, of course, does not take into account possible increases that could occur with further changes in farm programs.

High economic activity both here and abroad are sustaining a strong demand for United States farm products. Consumer incomes are at new highs and further expansion is in prospect this year. But as in recent years, the costs of processing and marketing foods are higher and much of the gain in consumer spending for food will reflect increased demand for services.

Cattle

"Cattle slaughter the rest of 1956 will be about the same as last year, but less will be of the top grades and more of intermediate and lower quality. A substantial rise in prices for top grades is in prospect this summer; prices of lower grades will likely decline seasonally."

Dairy

"Production of milk continues at record-breaking levels and will probably total 127 billion pounds for 1956, 3 percent more than last year. Purchases of dairy products for price support probably will be near those of the past year."

Poultry

"Egg supplies will continue seasonally large for the next few months and will probbaly be larger this fall than last. Mid-April broiler chick placements, which will determine marketings in early July, were at record levels."

Hogs

"The anticipated reduction in the 1956 spring pig crop will probably start a period of declining hog production. Hog slaughter will drop below a year earlier sometime this fall and will stay below for some time to come. Hog prices in the late months of this year are expected to average higher than the relatively low prices a year earlier."

Fats and Oils

"In 1955, civilians consumed about 45 pounds of fats and oils per person, the same as a year earlier. Total consumption of edible oils in 1956 is not likely to change much from last year."

"Soybean crushings continue at a record rate, but a strong demand pushed mid-April prices at Illinois shipping points well above a year ago. Big supplies are again in prospect for 1956."

Feed Grains

"A near record supply of feed grains is in prospect for the 1956–57 feeding year; acreage in 1956 will likely be smaller but record carryover stocks are in prospect. Supplies per animal unit may be a little less than in the current feeding year."

Wheat

"If yields are average, this year's wheat crop may total around 904 million bushels, only slightly more than the current rate of consumption plus export. Wheat prices have advanced recently, reflecting limited supplies in the market."

Cotton

"The supply of cotton for 1955–56 is estimated at 25.9 million bales. Estimated disappearance this year for domestic use and export of 11.2 million bales would leave a record carryover next August of 14.7 million bales." #

Protective Coatings

Continued from page 66

tended drying periods. The mortar is also an excellent exterior coating in resisting soil stress.

Properly formulated vinyl-resin and phenolic-resin paints provide serviceable interior coatings for steel water pipe and are not affected either by low atmospheric temperatures or by repeated cycles of wetting and drying. Phenolic priming paints and aluminum finish paint are also well suited for the exterior of exposed steel water pipe.

Glass mats and asbestos felt are effective wrapping materials for coal-tar enamel coating for buried steel piping. Glass mat reinforced enamel is resistant to soil stress, but because cracking will extend to the embedded glass reinforcement, thus reducing the effective enamel thickness, an additional asbestos felt is preferred as an outer wrap where clay soils make up the backfill.

Vinyl and polyethylene plastic tapes will provide effective exterior protection for straight pipe and welded joints. A primer is considered desirable to improve adhesion of the tape when it is applied in cold weather and to minimize possible rusting at tape overlaps. Glass-reinforced, coal-tar enamel tape also provides effective protection and is adaptable to wrapping fittings because it can be molded to shape thus making a good seal over irregularities. Double wrappings should be used for either type of tape in highly corrosive soils or those inducing severe soil stress.

Reclamation laboratory engineers plan to continue their tests of the coatings described and other materials being developed by the protective coating industry. From this research work, water users can be assured that the destructive and costly element of corrosion in Reclamation projects will be considerably lessened in the years to come.

# # #

CATTLE GUARDS

Continued from page 75

equipment through a gate or the much more frequent delays caused a ditch rider in opening and closing a gate. On some projects a compromise to the problems is to limit the construction of essential cattle guards to the carriage system and provide wire gates on the distribution system.

The delay in moving through a gate may be overcome by the use of bump gates. A gate of this type will serve both as a passage for equipment too wide for a cattle guard and as a means of keeping the stock from straying, without delaying the ditch rider. However, engineers object to bump gates, claiming that people using them will have to learn how to do so properly or maintenance will be high. These also is objection based on the concern that cattle may operate the bumper trigger, although factual information to substantiate this concern has not been obtained.

Another survey conclusion is that the greatest damage to all cattle guards results from the necessary use of the operating road for movement of construction or maintenance equipment, as well as the farmers' trucks and equipment. The damage is usually caused by the vehicles not passing properly through the cattle guard and at an angle or too close to a side guard. The result is a crushed and destroyed side guard. Accordingly, a curb or post of concrete, angle iron, or heavy timber at the base of each side guard, strong enough to withstand wheel impact, should be set near the side guard. One engineer has found that 7 by 7 inch redwood posts installed at either end of each side guard, painted white, and possibly fitted with red reflecting tape act as guides for the approaching vehicles. The posts are 4 feet long and buried 2½ feet in the ground so that 18 inches of the post extends above the surface.

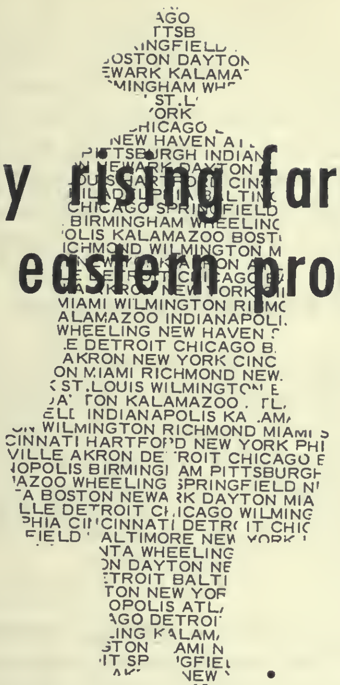
Although the survey reveals that many project engineers object to the original cost of building cattle guards, there is a tendency in replacement and repair of cattle guards to use steel and concrete construction in an effort to reduce replacements and maintenance costs in the future. Accordingly, the best and least expensive cattle guard will be one embodying lowest possible cost for materials, labor, and construction, consistent with expected low maintenance and replacement.

# # #

FRANK E. HULET ON TURKISH ASSIGNMENT

Frank E. Hulet of Boise, Idaho, who resigned from the Bureau of Reclamation on December 6, 1955, has begun a tour of duty in Turkey with Charles T. Mains, Inc., of Boston. Mr. Hulet's first employment with the Bureau of Reclamation was in 1930 on the Boise project. He progressed to powerhouse operator, foreman, and superintendent positions while serving on the Boise, Yakima, and Columbia Basin projects. In 1951 he became superintendent of power system operations of the Central Snake projects with headquarters at Boise, which position he held until he resigned.

early rising farmer buys eastern products



Editor's note: A Yakima farmer writing to his Congressman gives a vivid picture of the manufactured products of the East used by the average farmer on a Western Reclamation project. This letter has been published in several Washington State papers and the Reclamation News, official publication of the National Reclamation Association.

Here it is:

"Wakened at 5 o'clock by an alarm clock from Connecticut. I take the milk pails (Pennsylvania tin) and wend my way to the barn, while the wife prepares breakfast on a range from Kalamazoo, Mich. The breakfast, likely as not, will consist of grapefruit from Florida, breakfast food from Indianapolis, bacon from Omaha or Cedar Rapids, served on table china from Ohio or New Jersey, silverware from New York, sugar from Louisiana, etc.

"I will go to spray the orchard, using lead arsenate from Missouri, sulfur from Texas or Louisiana, nicotine from West Virginia (my smoke is a blend from North Carolina, Kentucky, and West Virginia), my spray rig is made in Michigan, the tractor in Wisconsin.

"When I go to town it is in a car from Indiana and Detroit, with tires from Ohio, bakelite accessories from New Hampshire. My car insurance goes to Baltimore, life insurance to Des Moines and Omaha, fire to Hartford, Conn. Shoes for myself and family come from Boston and St. Louis, clothing from New York or Chicago, cotton goods from Georgia, South Carolina or Mississippi.

"We ride over roads graded with machinery from Illinois or Iowa and paved by pavers from Wisconsin or Ohio. My plow comes from Moline, Ill., electric refrigerator, radio and other appliances from New York, Pennsylvania, or Detroit, furniture from Grand Rapids, bed springs from St. Louis, rugs from Philadelphia, my watch from Illinois, books and magazines from a dozen eastern cities.

"An occasional dose of snake bite preventive comes from Maryland or Kentucky; from Tennessee or Florida the ore that went into making the aluminum kitchenware; from Maine codfish and sardines; from Delaware, dyes and paint; and rayon and cellophane in numerous articles of daily use. The wife and daughter are strictly modern. Their cosmetics from New York, Pittsburgh or St. Louis amount to several ducats during the year.

"School books, toys, bicycles for the youngsters, like almost everything else, come the long trail from the eastern industrial centers and on all of these, as on the apples I shipped east, we pay freight that helps to maintain railroad service and dividends for eastern stockholders.

"The hardware and plumbing and heating plant in my house are all eastern products. The saw mill machinery that sawed and milled the lumber, the freight cars on which it was hauled and the rails over which they traveled all are eastern products—part of our annual cost of living bill.

"And when I make my last move to the little 3 by 6 plot on the hillside, I will doubtless be carried there on an eastern-made casket, borne by an eastern-made hearse. The kindly Yakima earth will be shoveled back over me with an eastern-made shovel, and at the head of the little mound will be set a stone of Vermont granite." #

"GET ACQUAINTED" COPIES

If you have friends or associates who would be interested in the RECLAMATION ERA, please send their names and addresses to the Bureau of Reclamation, Washington 25, D. C. We shall be glad to send them copies of back issues.

COLORADO-BIG THOMPSON PROJECT FEATURES RENAMED

Two major features of the Colorado-Big Thompson Federal Reclamation project, in Colorado, will be renamed to honor the late Charles Hansen, Greeley, Colo., newspaper publisher and prime organizer of the project.

The features scheduled to be renamed are the Horsetooth Feeder Canal and the Poudre Supply Canal. They will be known as the Charles Hansen Feeder Canal and the Charles Hansen Canal, respectively.

The change in the names has been approved by various private and public groups concerned, and will be formally proclaimed August 11, 1956, when northeastern Colorado plans to celebrate completion of the project's irrigation aspects, Reclamation Commissioner Dexheimer announced.

Mr. Hansen was President of the Northern Colorado Water Users Association from its inception in 1933 until it became the Northern Colorado Water Conservancy District in 1937. He headed the latter organization until his death in May 1953. This is the district which contracted with the Bureau of Reclamation to repay irrigation construction costs and has taken over operation and maintenance of the works as units were finished.

IT'S THE LAW

C. H. Spencer, Regional Director of the Bureau of Reclamation in Sacramento, recently announced that the California Highway Patrol and Sheriffs and other peace officers are fully authorized to take such measures as may be necessary to enforce the law on Federal land involved in the operation of Reclamation projects. Mr. Spencer, who is responsible for the Bureau's administration in Ventura, Santa Barbara, and California Counties to the north, and in part of Klamath and Jackson Counties, Oregon, noted that there are a large number of Federal Reclamation projects in the area. These include the Klamath, Orland, Central Valley, Sly Park, Santa Maria, Solano, Cachuma, and Ventura River projects.

"From time to time," Spencer said, "questions are raised as to whether State and local peace officers have jurisdiction on and adjacent to such reservoirs as Shasta, Millerton, Folsom, and Monticello, and the canal and road rights-of-way used for operations by the Bureau. Mr. William J. Burke, Regional Solicitor of the Interior Department, has informed that local and State peace officers do have the authority and indeed the duty to enforce laws on the Bureau's lands to the same extent that they are so authorized with respect to other areas in California. In addition, where theft or destruction of Government property is involved, the Bureau officials may seek the assistance of the Federal Bureau of Investigation."

Columbia Basin Items

Picture a sand dune 25 feet high and 10 acres big, moving onto an irrigated farm in an area where the rainfall is only 6–8 inches per year, the summers are dry, and the spring is windy. This is a condition which was controlled by planting stems of Volga giant wild rye on the Columbia Basin project.

* * * *

Washington State Highway Department budgets about 2 percent of its new highway costs for landscaping and grass seeding. This seems like a small sum until you realize the high costs of highways and how far a little grass seeding will go.

* * * *

2,4-D Spray note.—Large spray orifices are better than small ones. Use ½ to 1 g. p. m. orifices at low pressures. Why? Less drift and damage to crops. Easier to clean. May be used with screens in the line only.

* * * *

Before irrigation of Columbia Basin project lands, Grant County, Wash., received natural rainfall of 6–8 inches. Noxious weeds were few and concentrated along the intermittent Crab Creek. Five years after the first irrigation water was delivered, initial infestations of Canada thistle and perennial sow thistle were found over most irrigated lands. In one 45,000 acre area, 1,150 new weed patches on Bureau of Reclamation rights of way alone were treated with soil sterilants:

	Patches
1953	100
1954	300
1955	750
Total	1,150

How many weeds would have moved onto the farms without this preventive action?

LETTERS

Interested in Plastic Pipe

DEAR SIRS: I have been a subscriber of RECLAMATION ERA for some time now and have also enjoyed your most interesting article on irrigation.

Being a citrus grower and having some alfalfa land I am most interested in seeing an article in your magazine on a new material that has appeared on the horizon recently in our area, which seems to be making very good acceptance namely; plastic pipe and fittings. I would like to know how successful it has been in your department experience and more or less general information in plastic pipe and overhead type of irrigation. I am sure that a great number of farmers in the California area would also be interested in such an article.

Congratulations again on a very fine publication.

Yours very truly,
(Sgd) Ted R. Stevenson,
9527 Guatemala Ave.,
Downey, Calif.

We hope to present such an article in the near future.—Ed.

Finds Era an Aid

DEAR SIRS: You have been sending me the *Reclamation Era* to help me in my work at the University of Alabama. Your cooperation has been much appreciated.

I am leaving the University of Alabama to accept a position as Assistant to the Dean at the College of Engineering, University of Michigan. In this new position I will want to keep my contacts with employers and with associations that promote technical and professional development. A large part of my time will be counseling with students and I hope that your publication will continue to help me have a background that will be helpful to students.

My work at the University of Alabama will be carried on by several different persons, and for the time being, it will be helpful if you will continue to mail the *Era* to: Engineering Placement Office, Box 6127 University, Ala.

Thank you again for your service in helping one engineering educator keep up.

Sincerely,
WILLIAM D. MCILVAINE, Jr.,
P. O. Box 6127,
University, Ala.

Australian Interest

DEAR SIRS: I should like to express on behalf of the officers of this Department our appreciation for your kindness in making available to us the *Reclamation Era* which has always been of considerable value as well as being of great interest.

Yours faithfully,
UNDER SECRETARY,
Premier's Department,
Box 13, G. P. O., Sydney.

BOOKS

SOIL CONSERVATION
by Sellers G. Archer

The University of Oklahoma Press Norman, Okla.

Everyone is a conservationist of one kind or another—a good one or a bad one. The purpose of Soil Conservation is to highlight the critical problems associated with the use of our soil and to make it possible for all of us to become good conservationists.

In addition to being a guide to practical conservation, this book is a directory of information on agencies offering technical and financial assistance to farmers. Sources of information on financial and technical aid, cost-sharing programs, and other aspects of the many assistance agencies at local, State, and national levels are thoroughly discussed. Questions concerning the high costs of conservation projects and the mass of confusing information available on conservation are answered here.

What makes a good conservationist? Among other things, a good conservationist knows that soil is not expendable, and he will not permit himself either to use it up or to waste it. He is a good conservationist because he studies the cause and effect of every bit of soil movement on his land, and when he learns the cause, he remedies it as quickly as possible.

Today's answers to conservation problems are different from yesterday's, and there will be better answers tomorrow—because of the combined efforts of scientists, field workers, and others who have the hand and heart to apply themselves to the great task of soil conservation.

In this comprehensive treatment of the various methods of practical conservation, we have a book of, by, and for farmers and livestock men. It will prove valuable to the businessman with an investment in the land, and, to conservationists—good ones who are seeking improved methods, and bad ones who must change their ways—everywhere. #

DO YOU KNOW:

There is a divide in the Wind River Range, Wyoming, common to three major drainage areas: Colorado, Mississippi, and Columbia River Basin. ●

What the Indians term the "Wedding of the Waters" occurs at the mouth of the Wind River Canyon, Wyoming, where the waters of the Wind River become the Bighorn River. ●

At the time of its signing in December 1952, the $57,694,000 repayment contract between United States and the Weber Basin Water Conservancy District in Utah was the largest single repayment contract ever entered into by the Bureau of Reclamation. ●

Of the 17 States served by the Bureau of Reclamation, the States of Nebraska and North Dakota are the only ones having no igneous (granite, basalt, etc.) rock at the surface within their borders? ●

That every 6 years top engineers from the Bureau's Denver Engineering and Regional offices, accompanied by representatives from water users' organizations, give every major Bureau structure a top-to-bottom inspection? Results range from suggestions for improving the appearance of exterior surfaces to recommendations that major rehabilitation be undertaken. This is in addition to regular annual inspections of equipment and structures. The Bureau's comprehensive inspection program insures maximum safety and economy for the water user's dollar. ●

That underwater television equipment has been used to help Bureau engineers determine the condition of submerged concrete in Bureau structures? Privately developed equipment of this type was used to determine the condition of spillway concrete at Shasta Dam recently. In the survey, which took place from a barge floating in the spillway, a diver at the bottom scanned the surface of the concrete with a spotlight-equipped television camera and transmitter. The resulting images were picked up by television receivers on the barge. Advantages: Engineer experts get a direct view of underwater conditions, and do not need to depend entirely on verbal reports from professional divers; and a permanent record can be made by photographing the screen of the television receiver. ●

Atomic Energy may mean Agricultural revolution—A recent report by the United Nations Food and Agricultural Organization points to possible revolutionary applications of atomic energy to farming and reclamation. According to the report, "The use of radio-isotopes * * * is already leading to greater efficiency and economy in the production and utilization of agricultural products * * * (and) the potential value may be almost unlimited." The report points out how research with atomic materials is leading to improved techniques of soil treatment and application and drainage of irrigation water, the use of fertilizers and weed killers, the art of selective breeding, and many other fields related to agriculture. It may lead to important decreases in food storage and shipping losses, and field losses to insects and plant diseases. The report estimates the latter at $13 billion yearly in the United States alone.

Making their contributions to this new art, Bureau of Reclamation engineers are using atomic materials to study the effectiveness of weed-killing chemicals, and are studying the application of atomic radiations to the measurement of soil density and moisture content. ●

MAJOR RECENT CONTRACT AWARDS

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DC-4458	Weber Basin, Utah	Apr. 24	Construction of earthwork, concrete pipe lines, and structures, and concrete or steel pipe for trunk lines, Davis aqueduct, station 934+98 to 1144+60.	W. W. Clyde & Co., Springville, Utah.	$894, 576
DC-4561	Yakima, Wash	Apr. 18	Furnishing and installing 1 11,250-kilowatt vertical-shaft generator for Roza powerplant.	American Elin Corp., New York, N. Y.	223, 260
DC-4604	Missouri River Basin, Nebr.	Apr. 10	Construction of earthwork and structures for Upper Meeker canal, station 0+75.42 to 567+00; and road relocations and drains.	Ace Construction Co., Omaha, Nebr.	806, 095
DC-4607	Columbia Basin, Wash	Apr. 3	Construction of earthwork and structures for Royal Branch canal, station 1+17 to 451+58.85; Royal Branch canal wasteway, station 0+00 to 75+00; Crab Creek lateral, station 123+77.2 to 167+00; and Crab Creek lateral extension, station 0+00 to 372+56.5.	West Coast Construction Co., Inc., Seattle, Wash.	484, 347
DC-4616	Weber Basin, Utah	Apr. 10	Construction of East Bountiful and South Davis pumping plants.	Nelson Bros. Construction Co., Salt Lake City, Utah.	147, 529
DS-4617	Missouri River Basin, Wyo.	Apr. 18	2 174-inch butterfly valves for Glendo powerplant	Todd Shipyards Corp., Seattle Division, Seattle, Wash.	278, 574
DC-4625	Columbia Basin, Wash	Apr. 12	Construction of earthwork and structures for Part 4 of Block 18 laterals, wasteways, and drain, West Low canal laterals.	Henry C. Werner and Tauf Charneski, Eugene, Oreg.	242, 647
DC-4630	do	Apr. 3	Construction of Evergreen pumping plant, Block 77	Big Bend, Inc., Seattle, Wash.	361, 744
DS-4631	Missouri River Basin, Wyo.	Apr. 27	Seven 115-kv. power circuit breakers for Glendo switchyard.	General Electric Co., Denver, Colo.	177, 038
DC-4636	Columbia Basin, Wash	May 1	Construction of earthwork, pipelines, and structures for North part of Block 46 laterals, wasteways, and drains, East Low canal laterals.	Donald M. Drake Co., Portland, Oreg.	402, 585
DC-4640	Middle Rio Grande, N. Mex.	Apr. 12	Channelization of the Rio Grande, South boundary of Fish and Wildlife Refuge to San Antonio, N. Mex., Socorro area, station 0+00 to 627+00.	D. D. Skousen & Son, Albuquerque, N. Mex.	732, 801
DC-4647	Owyhee, Oreg.-Idaho	May 2	Rehabilitation of Ontario-Nyssa pumping plant	Utility Construction Co., Ontario, Oreg.	157, 846
DC-4650	Central Valley, Calif	May 8	Construction of Trinity Dam diversion tunnel	Gates & Fox Co., Burlingame, Calif.	1, 348, 000
DC-4656	Columbia Basin, Wash	do	Construction of earthwork and structures for Evergreen pumping plant intake channel and discharge lines, lateral W44, and dike 44, Block 77 of West canal laterals.	Donald M. Drake Co., Portland, Oreg.	569, 271
DC-4661	Missouri River Basin, Wyo.	May 22	Construction of earthwork and structures for Main Canal No. 1 and lateral; and Main Canal No. 2 and laterals, schedule 1.	D. M. Manning, Hysham, Mont.	501, 895
DC-4661	do	May 23	Construction of earthwork and structures for Bluff laterals Nos. 1 and 2, schedule 2.	Long Construction Co. Inc., Billings, Mont.	179, 784
DC-4662	Weber Basin, Utah	June 15	Construction of Slaterville diversion dam and Layton pump intake channel, Parts A and C.	Mountain States Construction Co., Bountiful, Utah.	458, 587
DC-4667	Columbia Basin, Wash	May 8	Construction of earthwork and structures for Part 1 of Block 18 laterals and wasteways, East Low canal laterals.	Donald M. Drake Co., Portland, Oreg.	415, 977
DC-4670	Michaud Flats, Idaho	June 13	Construction of American Falls pumping plant and discharge line.	W. R. Cahoon Construction Co., Pocatello, Idaho.	579, 890
DC-4671	Chief Joseph Dam, Wash.	June 6	Construction of Bridgeport Bar pumping plants and distribution system.	Harold Kaeser Co., Seattle, Wash.	289, 477
DC-4672	Columbia Basin, Wash	May 29	8 horizontal, centrifugal-type pumping units for Frenchman Springs pumping plant, Block 79 of West canal laterals.	Worthington Corp., Harrison, N. J.	123, 268
DC-4676	Santa Maria, Calif	June 14	Construction of Vaquero dam and access road	Mittry Construction Co., Los Angeles, Calif.	6, 179, 639
DC-4679	Missouri River Basin, Wyo.	June 12	Construction of access road tunnel, Fremont Canyon powerplant.	Guy H. James Construction Co., Oklahoma City, Okla.	393, 700
DC-4681	Missouri River Basin, Nebr.	June 20	Construction of earthwork and structures for Sargent canal, station 1109+76.59 (AH) to 2118+60 (end); Sargent laterals, second section; and Airport wasteway and drains.	Cook Construction Co., Jackson, Miss.	1, 167, 900
100C-242	Minidoka, Idaho	June 12	Construction of laterals from group 7 wells	Duffy Reed Construction Co., Twin Falls, Idaho.	135, 205
100C-243	do	June 5	Completion work for group 4 wells	Fonnesbeck Construction Co., Idaho Falls, Idaho.	115, 714
200C-311	Solano, Calif	June 19	Clearing 17,270 acres of Monticello reservoir site, Part II	Schutt Construction Co., Inc., Springfield, Oreg.	1, 144, 500
300C-81	Colorado River Front Work and Levee System, Arizona-California-Nevada.	Apr. 20	Construction of 1 heavy-duty tugboat	Gunderson Bros. Engineering Corp., Portland, Oreg.	157, 327

Construction and Material for Which Bids Will Be Requested Through September 1956[1]

Project	Description of work or material
Central Valley, Calif.	Earthwork and structures for Shafter-Wasco laterals and sublaterals 134.4 and 137.2 will include about 82 miles of 12- to 24-inch precast concrete or cement-asbestos pipe and about 26 miles of 27- to 72-inch precast concrete pipe. Near Shafter.
Do	Constructing bridge substructure and approaches for county road crossing of Trinity River, constructing 4.5 miles and improving about 9 miles of county road around Trinity Dam site, and constructing 4.5 miles of access road near Lewiston.
Do	Constructing 45 two- and 45 three-bedroom residences, 145 carports, and other buildings for a 500-person community. Work will include water storage, electrical system, and streets near Lewiston.
Chief Joseph Dam, Wash.	Constructing 1 outdoor-type 50 cfs pumping plant with fish protection facilities, an indoor-type booster plant, and an outdoor-type relift plant, near Brewster.
Do	4 motor-driven, deep-well, turbine-type pumping units, each with a capacity of 11.7 cfs at a total head of 190 feet; 4 motor-driven, horizontal, centrifugal-type pumping units, each with a capacity of 11.7 cfs at a total head of 350 feet; and 3 motor-driven, horizontal, centrifugal-type pumping units, each with a capacity of 13 cfs at a total head of 150 feet, part of the Brewster Flat Pumping Plants.
Colo.-Big Thompson, Colo.	1 6,500-hp., 400-r. p. m., 180-foot-head, vertical, Francis-type turbine and 1 4,500-kv.-a., 1.0 power factor, 4,160-volt, 400-r. p. m., vertical-shaft, hydraulic-driven, synchronous generator for the Big Thompson powerplant.
Colorado River Storage, Ariz.	Excavating in open cut and in tunnel for the 2,700-foot-long, 50-foot-diameter, unlined right abutment diversion tunnel at the Glen Canyon Dam site. About 135 miles north of Flagstaff.
Do	Constructing about 25 miles of access highway to Glen Canyon Dam site, including Water Holes Canyon Bridge and drainage structures, about 115 miles north of Flagstaff.
Columbia Basin, Wash.	Earthwork and structures for the concrete and steel pipe Wahluke Siphon which will include 13,000 feet of 12-foot monolithic or precast concrete pipe and 2,500 feet of 11-foot 2-inch plate steel pipe on concrete piers, south of Othello.
Do	Earthwork and structures for about 7 miles of unreinforced concrete-lined open laterals, about 2.3 miles of unlined open laterals with bottom widths of from 4 to 2 feet, and about 2.2 miles of unlined wasteway channel with a 2-foot bottom width, near Burbank.
Do	Earthwork and structures for about 40 miles of unlined open laterals and wasteways with bottom widths varying from 8 to 2 feet. Block 79, about 15 miles south of Quincy.
Do	Constructing irrigation facilities to serve 8 new farm units in Block 74, near Quincy.
Do	Constructing the White Bluffs Pumping Plant, an indoor-type plant with 4 electrically driven horizontal pumping units of 178-cfs total capacity and installing a heating and ventilating system, on the right bank of the Columbia River, at Grand Coulee Dam.
Do	4 synchronous, motor-driven, horizontal, centrifugal-type pumping units, each with a capacity of 41.3 cfs at a total head of 85 feet for White Bluffs Pumping Plant No. 1.
Michaud Flats, Idaho.	Constructing 7.5 miles of welded steel pipe laterals for sprinkler-type irrigation, near American Falls.
Minidoka, Idaho	Earthwork and structures for laterals from 25 wells and for 6 relift pumping plants and discharge lines. Near Rupert.
Do	Drilling and casing 33 drainage wells of 8-, 12-, and 16-inch diameters with depths ranging from 200 to 400 feet. North Side Pumping Division, near Paul.
Missouri River Basin, Kans.	Earthwork and structures for the Courtland and Miller Canals and laterals including 14.8 miles of unlined open canal with bottom widths varying from 20 to 6 feet and about 28.8 miles of unlined open laterals with bottom widths varying from 6 to 3 feet, north of Courtland.
Missouri River Basin, Mont.	Constructing a 7-foot horseshoe tunnel about 2.6 miles long. Helena Valley Tunnel, 15 miles east of Helena, adjacent to Canyon Ferry Dam.
Do	Constructing the outdoor-type Helena Valley Pumping Plant of reinforced concrete with a structural steel crane runway and overhead traveling crane and an approach bridge, near Helena.
Missouri River Basin, N. Dak.	Constructing facilities for a radio communication system, including 15 10- by 14-foot prefabricated metal buildings, 2 100-foot and 13 200-foot radio towers with antennas, cable and lights, underground audio telephone and control lines between buildings, and underground power cable. Several areas in North Dakota.
Missouri River Basin, Wyo.	Bids will be received on the 2 following alternate proposals: Constructing an earthfill dam (Anchor Dam) with crest 175 feet above streambed and 460 feet in length, a spillway with approach channel, concrete inlet structure, concrete-lined tunnel, concrete conduit and stilling basin, and riprap-lined outlet channel, an outlet works with concrete intake structure, lined tunnel, gate chamber adit and access shaft, shaft house, and ventilating system, and constructing 1 mile of access road with drainage structures. Constructing a 66,000-cubic-yard concrete arch dam (Anchor Dam) 200 feet high and 550 feet long and constructing 1 mile of access road with drainage structures. Anchor Dam to be located on the South Fork of Owl Creek, about 35 miles west of Thermopolis, Wyo.
Do	Constructing 5 miles of road including a 140-foot truss bridge for access to Fremont Canyon powerplant on North Platte River, 40 miles southwest of Casper.
Do	2 33,500-hp, 257-r. p. m., 300-foot-head, vertical-shaft, Francis-type turbines and 2 25,263-kv.-a, 0.95 power factor, 11,500-volt, 257-r. p. m., vertical-shaft, hydraulic-driven, synchronous generators for Fremont Canyon powerplant.
Rogue River Basin, Oreg.	Constructing the 86-foot-high earth and rockfill Howard Prairie Dam and appurtenant structures, on Beaver Creek, about 18 miles east of Ashland.
Do	Constructing approximately 12 miles of open canal and a small rockfill type diversion dam with reinforced concrete core wall, sluiceway and canal headworks, 15 miles east of Ashland.
Do	1 16,842-kv.-a, 0.95 power factor, 4,160-volt, 600-r. p. m., vertical-shaft, hydraulic-driven, synchronous generator for Green Springs powerplant.
Solano, Calif	Constructing a steel beam bridge on steel bearing piles with a reinforced concrete deck about 200 feet long over Putah Diversion Dam pool. About 4 miles southwest of Winters.
Do	Earthwork and structures for about 12.8 miles of 10-foot bottom width unreinforced concrete-lined canal. Putah South Canal, near Vacaville.
Weber Basin, Utah.	Constructing the Wanship and Gateway powerplants, near Wanship and Ogden.

[1] Subject to change.

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The Reclamation Era

November 1956

IN THIS ISSUE:

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The Reclamation Era

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In this issue . . .

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Bureau of Reclamation, Washington, D. C.
J. J. McCARTHY, Editor
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* * *

30 Years Ago in the Era

FEDERAL RECLAMATION

While just at this time reclamation is almost synonymous with irrigation of arid lands, we do not lose sight of the fact that that word and the policy of the Government include reclamation by drainage of swamplands, by development of cutover timberlands, and by fertilization of exhausted farmlands all through the eastern part of the United States. All will be needed in time. Our national necessities will compel us to go forward all along the productive line.

Reclamation is not only a matter of producing food for our people. The great thing is the transformation of the wilderness to civilization. It is the occupation and cultivation by the capital and labor of the settler of the unoccupied lands of this country. It is the creation of taxable wealth to help sustain the Government for all future times. It is the establishment of homes. * * *

From an address in the House of Representatives
by Hon. CHARLES E. WINTER, of Wyoming

saving lives on central valley canals

LIFE PRESERVER SHELTER erected at Mile 5.7 Friant-Kern Canal.

by H. E. VAN EVERY
Water Maintenance Engineer
Region 2, Sacramento, Calif.

Every irrigation project has the problem of trying to protect the public. This is magnified on the Central Valley Project in California, by the fact that a million and a half people live within easy commuting distance of the four main canals, the Contra Costa, Delta-Mendota, Madera, and Friant-Kern. The canals are swift, deep, full of fish, and temptingly inviting in the semiarid San Joaquin Valley, and the adjoining Contra Costa County.

The Antioch, California, "Ledger" editorialized May 10, 1956:

"Another danger tempter in this area is the Contra Costa Canal.

"Signs have been tried, to warn youngsters and oldsters to stay out of the canal. To keep children out, an expensive patrol has been provided to police the banks of one of Contra Costa County's most vital assets. Now they are putting safety rings (lifesaver rings and shelters) along the slopes of the canal.

"The Reclamation Bureau and the Contra Costa County Water District are no more responsible, financially, for a death in this canal than they are for one in the San Joaquin River, nor any reservoir in this county.

"Trespassers should be penalized for entry rather than their survivors being paid a premium."

To date all deaths from drowning in Central Valley Project Canals, with one exception, have been attributable to trespassing. To protect the trespassers the Bureau has installed a number of protective devices, such as ladders, chain link fencing, warning signs, log booms, etc. The latest protective feature has been the erection of life preserver shelters, complete with life rings and rope, at strategic locations along the canals.

The shelters were first tried in 1953 on the Contra Costa Canal in the vicinity of Concord. Later they were added on the Friant-Kern, Madera, and Delta-Mendota Canals, as well as increasing the number on the Contra Costa Canal, until now 105 shelters have been erected. While it is impossible to foretell where drownings will occur, the attempt has been made to locate the shelters at siphons, checks, and bridge locations which are liable to be visited by the greatest number of people.

So far as is known no Bureau employee has made use of the life rings or has observed others making use of them. It is known that there have been no drownings at any of the locations since the installation. Several of the glass fronts have been broken and the rings removed, indicating possible legitimate use. In other cases it appears reasonably certain that the damage to the shelters has been due to vandalism.

Efforts have been made to publicize the erection of the shelters and the vandalism. The Tracy Operations Field Branch, which has charge of the

Contra Costa and Delta-Mendota Canals, directed letters to all of the local newspapers along those canals announcing the installations of the shelters and requesting the newspapers to publish this information. Several of the newspapers responded. The Fresno Operations Field Branch, in charge of the Friant-Kern and Madera Canals, was having vandalism troubles in the Orange Cove and Delano areas. The "Orange Cove News" and "News of Delano" cooperated by publishing editorials dealing with the damage to the shelters and its possible effect on the saving of a life.

Each installation costs about $32 complete. The single strength glass front must be broken to remove the ring and rope. The shelters were designed in this manner, similar to a fire alarm box, in the hope that ring and rope removal would occur only in case of need. The rings are balsa or cork to ensure that they will not be damaged by flying glass. The balsa type are preferred as cork tends to deteriorate somewhat with age. Normal maintenance of the shelters is a coat of white paint every 3 years and replacement of glass after use.

The shelters fulfill two functions. It is believed that they are much more effective than any warning sign in calling attention to the inherent danger of being on the edge of the canal or swimming in the canal, and at the same time they provide a means of rescue for those disbelievers who find themselves in the canal.

# # #

Top left: LIFE PRESERVER SHELTER on Delta-Mendota Canal. At left: SIX SAFETY DEVICES at inlet of siphon on Madera Canal. (1) Life preserver shelter; (2) Danger warning sign; (3) Safety fence around inlet; (4) Safety net across canal; (5) Sign on lining reading "STAY ALIVE BY STAYING OUT"; (6) Ladder leading out of canal. Top right: EFFECTS OF VANDALISM on shelter at Friant-Kern Canal.

Another Concept of Irrigation Farming

This article is based on a speech made by Master Farmer Idus T. Gillett of the Rio Grande Project before the El Paso Rotary Club on January 27, 1956.

Master Farmer Idus T. Gillett of the Rio Grande Project has completely changed his method of farming. He has not done this entirely by acquiring the most modern types of equipment and following the latest practices with respect to conservative and beneficial methods of irrigation on a typical western project. True he has done these things and is in every respect modern in his farm equipment, and in the layout of his well-levelled fields. In addition, he has reverted to "natural" farming or to farming methods that may have been practiced for thousands of years in China and other parts of the Far East and Near East where farming techniques of tilling the soil do not meet our high standards but nonetheless provide from time to time surprises as to what can be accomplished with very old methods. However, his decision to change was the result of his own personal observations, and belief that farming and tillage of the soil was deviating too rapidly from nature's way of building and restoring soils.

What has Gillett done to change his original farming practices? Well, to put it in a nutshell, he has begun to practice organic farming and the use of the soil probably as nature originally established the pattern. When he, shortly after the turn of the century, began farming 13 miles up the Rio Grande from the City of El Paso, the soil was friable and impregnated with leaf mold, with angle worms in evidence in profusion. Fertility was the byword. To prepare the soil required only a team of small horses for plowing. Crop production was high. Wheat grew shoulder high, with heads six inches long, with no lodging, and strangely, with no disease. Alfalfa was so rank that it was necessary to put three animals on the mowing machine with the cut running 3 tons per acre per cutting. Roots were deep, going down as far as 20 feet. Such was the condition of the soil and productivity on the family farm when Gillett was a young man. Comparing that type of production with what is happening in the area today, brings into focus the reason why he decided something should be done. Alfalfa today, or perhaps it should be said, prior to the drought conditions now existing on the Rio Grande Project, produced 4 to 6 tons per acre, with roots going down 18″–24″. Cantaloupes which formerly produced 300 crates to an acre now average 75–125 crates to the acre, with only the exceptional lands exceeding the average.

Six years ago, Gillett decided to begin organic farming and to discontinue as rapidly as possible the use of commercial fertilizers, dusting, and sprays. He began by developing a compost pile in order to manufacture humus. Into the compost pile he puts everything that has "lived and died,"

MASTER FARMER GILLETT is proud of this corn grown organically on his farm.

provided none of it has been subjected to poisons. In starting the compost pile, a day is chosen, when possible, following a rainstorm which permits the removal of the manure from the corrals in a moistened state. As a starter or charge, a layer from a former pile is placed on top of the new bed. Then the bed is thoroughly wetted and is turned over in about 30 days. It is important that a liberal supply of natural mineral rock, such as phosphate, potash, oyster shell and cottonseed is mixed into the compost, preferably during the turning process, further dampening, if necessary, and exercising care not to apply an excess of water. The object, of course, is to provide a favorable media for the billions of bacteria that will develop. The compost is ready for use when the color changes to that which would be found under big trees in forest areas. It should have a good pungent, earthy smell.

Distribution of the compost is made on the land in several ways: One, the material is introduced directly into the irrigation water; another, it is distributed along the ditch bank near the turnouts to the land, where it will be picked up and distributed by the irrigation flow; finally, by using the conventional manure spreader. Idus is convinced through his experience that the use of compost on a major scale gives his land the added humus which is necessary. The application through the irrigation water, in effect, creates a condition resembling yeast, in that the bacteria floating in the water attaches itself to every blade of grass, every root, and each stalk that has been turned over from the previous crop, which then eventually becomes very much like the original humus of the compost pile. Three tons of applied compost per acre per year actually gains in volume by several more tons, by turning over the residue of the previous crop into the compost material—another reason for not always removing the stalk cuttings entirely from the fields. It is axiomatic that humus enriches the soil and increases the water-holding capacity that promotes the growth and development of the essential fungi, algae, and hormones in the soil, as well as the transfer of nutrients from the soil to the growing plants.

THE "CALF-LINE" shows excellent beef stock produced with organically grown forage, grain, and hay. *Photo by Bob Gilbert.*

Angle worms now enter the picture. Restoration and continued feeding of humus to his soil has permitted an increase in the angle worm population of the soils. The angle worm is perhaps the original tiller of the soil. It has been estimated that if 8 angle worms to a square foot of soil are available, there will be produced 15 tons of the finest fertilizer each year per acre; their working, burrowing, and chewing keep the soil open and porous. In soils where they are present in great population, one may except an increase of up to 400 percent in manganese, 500 percent nitrogen, 700 percent phosphate, and 1,100 percent potash over that in a comparable soil in an original state without worms.

Before the development of the compost piles as a basis for fertilizer was started, it was difficult for a farm tractor to pull a single-bottom plow and then it could only be done in first gear. The second year after having applied organic matter, the same tractor with the same driver was able to pull a two-bottom plow. During the third year, Idus sold the plow and has not plowed for the last three years. The procedure now is to disc lightly and chisel about 20 inches deep. All this made possible by the change in the character of the friability of the soil.

The experience of Gillett is convincing not only from the standpoint of the greater ease of tilling his soil but also in the increased fertility and the production of higher grade crops than was formerly the case. It seems unbelievable that it has not been necessary to plow his land for three years; but it is not necessary to take it on faith, as it is well known to Idus' neighbors that such has been the case. Why? Well, organic farming plus the angle worms to do the plowing.

Gillett is firmly convinced that the quality of vegetables grown under organic farming methods are superior to those grown under accepted methods. His vegetables are produced from plants that throughout the growing season are healthy, well nourished and exceedingly tender. He never dusts or uses sprays, as the natural healthiness of

FARMER GILLETT in field of dwarf Pima Cotton—staple length 1 1/2". This cotton, grown only in the SOUTHWEST, yields better than 1 1/2 bales per acre. *Photo by Bob Gilbert.*

the plants grown under the organically prepared soils provides a natural resistance to pests and disease.

An example of the resistance to pests is the experience on this farm several years ago when leaf worms were particularly bad in the area. It was necessary for his neighbors to dust and spray as many as eight times, but the organic farm was not sprayed nor dusted once. The final result was that the organically grown plants appeared much healthier than those that had been sprayed so often.

Similar conditions have been observed with respect to the feeding of organically grown hay and grain to livestock. As an example, Gillett, whose farming activities also included dairying, cites the case of his experience with a milk cow. This cow was producing 13 quarts of milk on chemically fertilized hay; then she was switched to organic hay. In fact, she was given a choice and, after sampling, immediately began feeding on the organic hay, with the result that her production increased to 16 quarts. Later the organic hay was taken away and the cow was returned to the old hay. Her production dropped back to 13 quarts. The process was repeated and the cow on organically grown hay again increased her production to 16 quarts. Gillett made this experiment after he had closed out his dairy herd of 125 cows. Imagine how his milk production would have increased with his 125 cows had he known the benefit of organic farming at that time.

Gillett could not be pursuaded to give up organic farming. His costs have gone down, while his production has gone up. His fertilizer bills have been cut 50 percent, the cost of preparing his land has dropped 15 percent, and dusting by airplane has been discontinued entirely. Gillett is convinced that farmers would be much better off if they would go in for the compost pile in a major manner, and encourage and cultivate the repopulation of the soil with angle worms. # # #

TREAT DITCHES WITH CMU

Having trouble keeping small laterals weed-free? Extensive field trials of the chemical CMU by Dean Schacterle of Reclamation's Kansas River Projects Staff and Hans Ploeg, DuPont's technical representative, shows the chemical can do a good job on most annuals and some perennial weeds.

The chemical was applied at a rate of 10 lbs./A on light textured and 15 lbs./A on medium-textured soils in early spring before irrigation deliveries started. Tests were also made using fall applications at increased rate of 15 lbs./A on light textured and 20 lbs./A on medium-textured soils. Both the fall and spring applications were equally effective at the above rates. The bottom and inside slopes of the ditches were treated. If rains do not occur which fix the chemical in the soil, then this "fixing" should be done by filling the ditch with water and either letting it soak into the ditch bank, or waste the water after a period of 72 hours. After this fixing occurs, the chemical "stays put" thus preventing damages to crops. In the trials the ditches remained weed-free throughout the irrigation season. Because the chemical is nonselective, weedy grasses were also controlled.

The application rates suggested above apply to the eastern part of the Great Plains; from Scottsbluff, Nebr., westward, higher rates may be required.

Cost of the treatment runs about $30 to $40 per mile of ditch. Although at first glance this cost may appear high, it compares favorably with other methods such as two or more burnings per year and is much less in some cases.

YOUR MAGAZINE

Are there particular types of articles which you would like to see in the ERA that we have not printed to date? If so, please let us know, and we shall do our best to comply with your wishes.

NRA Celebrates Silver Anniversery

MARSHALL N. DANA, N. R. A.'s First President.

GUY C. JACKSON, N. R. A.'s Present President.

The 25th Annual Convention of the National Reclamation Association, marking its Silver Anniversary, is scheduled to be held at the Hotel Utah, Salt Lake City, Utah, on Wednesday November 14 continuing through Friday, November 16.

Mr. William E. Welsh, the Association's Secretary-Manager, announced the preliminary plans for the Convention after conferring with President Guy C. Jackson and other officials of the Association from the various Western States. Indications are that the meeting will be the largest in the Association's history attendancewise and the speakers will include nationally known authorities in the field of conservation.

Senator George W. Malone of Nevada is scheduled to be the speaker at the opening day luncheon session on November 14. His address is to be followed by the transaction of Association business, including reports from President Guy C. Jackson of the N. R. A. and other officials.

Others scheduled to address the Convention include Senators James E. Murray of Montana and Arthur V. Watkins of Utah; Governor J. Bracken Lee of Utah; Congressmen Clair Engle of California, A. L. Miller of Nebraska, and Wayne N. Aspinall of Colorado; Assistant Secretary of Agriculture Irving Peterson; and Major General E. C. Itschner, Chief of the Army Engineers.

Secretary of the Interior Fred A. Seaton and Commissioner of Reclamation W. A. Dexheimer are scheduled to deliver major addresses on Reclamation policy and outline plans for the Bureau's future.

Other Interior Department and Bureau of Reclamation officials who will attend the 25th Annual Convention are Associate Solicitor for Water and Power Edward W. Fisher; Assistant Commissioner of Reclamation E. G. Nielsen; Assistant to the Commissioner—Information, Ottis Peterson; Chief, Division of Irrigation, Floyd E. Dominy; and Chief, Division of Project Development, N. B. Bennett, Jr.

Origin of N. R. A.

The late Governor George Dern of Utah called a conference at Salt Lake City, Utah, for December 5, 1932, in connection with the conference of the Western Governors which followed on December 6 and 7 and dealt with the problems of Federal Reclamation. There were 91 delegates to the reclamation conference. At this time an organization was effected to be known as the National Reclamation Association, and the following officers unanimously chosen: President, Marshall N. Dana, Associate Editor, Oregon Journal, Portland, Oregon; Secretary, Kenneth Miller, Agricultural livestock agent, Spokane, Portland, and Seattle Railway, Portland, Oregon; First Vice President, Sam Stephenson, of Montana; Second Vice President, W. R. Wallace, of Utah; Treasurer, E. O. Larson of Utah. Mr. Larson is now

FRED A. SEATON, Secretary of the Interior.

W. A. DEXHEIMER, Commissioner of Reclamation.

the Bureau of Reclamation's Regional Director at Salt Lake City, Utah.

The Executive Committee consisted of Perry Jenkins, Wyoming; George W. Malone (present United States Senator) of Nevada; Sam Stephenson of Montana; and A. B. Tarpey of California.

At this first meeting of the N. R. A. the following resolution was unanimously adopted by both the Association and the Governors' conference:

"On the third decennial of Federal reclamation, it is fitting that we pay tribute to the memory of that great President of the United States, Theodore Roosevelt, whose broad vision and statesmanship was responsible for and under whose administration the beneficient policy of Federal reclamation was inaugurated in 1902.

"His familiarity with the West was such that he clearly envisioned its future. He realized that reclamation was of such scope and of such economic importance to the welfare of our entire country as to justify and require the aid and direction of the Federal Government, and his dominancy and clear-visioned statesmanship in the matter prevailed.

"As a result, the West has increased its population, in wealth, in commerce and trade, and it has provided a defensive strength and security for the whole Nation. Within the short period of 30 years an internal trade has developed between the western semi-arid States and the other States of the Nation amounting annually to hundreds of thousands of cars of railroad cargo and to an enormous tonnage of ship cargo. These Western States send eastward their fruit, their lumber, their fish, their cattle and sheep, and their other raw products and receive in exchange the more expensive finished products of the industrial East.

"Since the initial passage of the reclamation act the Federal government has reclaimed nearly 3,000,000 acres of land, has provided rural homes for 60,000 families, has been responsible for a like increase in urban population, has added a billion dollars to the Nation's taxable wealth * * *. It is to preserve these values, and to hold a continuing policy of Federal reclamation, as contemplated in the original act, that we again militantly dedicate ourselves in order that the great work inaugurated by Theodore Roosevelt when President of the United States may go on unabated." To these ends, therefore, we offer the following specific resolutions:

"Whereas we believe that the broad principle of Federal aid to reclamation should be extended to economically sound projects of regional and national importance too costly for local or community effort, we hold that the immediate construction activity of the Bureau of Reclamation should be mainly confined to providing supplemental water supplies and completing or reconstructing works on existing Federal and non-Federal projects which are economically sound and on which such aid is urgently needed. * * *

"Whereas we deem the existence and continuance of the Bureau of Reclamation of vital importance to the West and the entire Nation;

"Whereas it has been the policy of every administration to appoint a western man as Secretary of the Interior, and selections have been able men with an intimate knowledge of western problems;

"therefore be it

Resolved: We urge the Bureau of Reclamation be maintained as a part of the Interior Department, which alone has acquaintance with the problems of water administration and conservation. * * *."

# # #

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Artist's Conception of FLAMING GORGE DAM, Colorado River Storage Project.

JEAN R WALTON NAMED Construction Engineer ON FLAMING GORGE

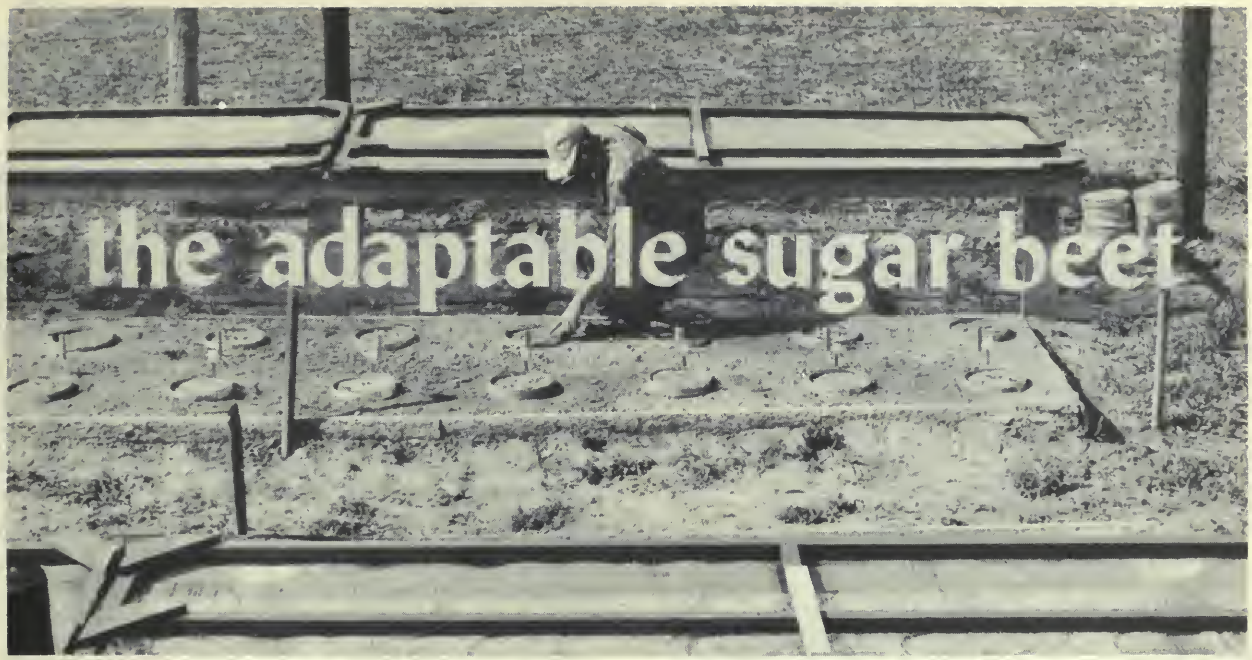
Commissioner W. A. Dexheimer has selected Jean R. Walton as Construction Engineer on the Flaming Gorge Dam in Utah. This is the second of the big three "starts" on the Colorado River Storage Project for which the top man has been named. L. F. Wylie is the Construction Engineer on the Glen Canyon Dam. (See August 1956 *Reclamation Era*). As this issue went to press no one had been selected to head up the Navajo Dam job, in New Mexico, the last of the big three.

Mr. Walton, who received his B. S. degree in Electrical Engineering from the University of New Mexico, has been with the Department of the Interior since 1935. His first position was with the Bureau of Indian Affairs. The following year he joined the Bureau of Reclamation as Assistant Engineer on the Pine River Project in Colorado and held progressively responsible assignments until he entered the military service in 1942.

He returned to the Bureau in Denver in February 1946, becoming Field Engineer at Davis Dam in June of that year. He was appointed Construction Engineer on this job in 1950 and completed the construction program including installation of the powerplant facilities, generators, and switchyards. Upon completion of the Davis Dam job, Mr. Walton transferred, as Construction Engineer, on the second barrel of the San Diego Aqueduct Project at Escondido, California. Subsequently, he served on a two year mission as advisor on construction problems on the Snowy Mountain Project in Australia.

On the Flaming Gorge Dam job he will be temporarily headquartered at Vernal, Utah. Construction of an access road and temporary bridge were scheduled for October. Construction on the diversion tunnel, temporary housing units, and administration buildings are planned in the spring of 1957.

The 450-foot-high Flaming Gorge Dam will be a concrete structure on the Green River, a tributary of the Colorado River. The dam site is in the Northeast corner of Utah, near the Colorado and Wyoming border. #



ONE of 17 widely scattered locations throughout the U. S. where climatic differences are studied. Pots contain vermiculite, an inert material, and all nutrients were applied in a solution, which was uniform throughout the country. ***Photo by P. B. Smith.***

by G. D. MANUEL, Vice President and General Agriculturist, Spreckels Sugar Company San Francisco, Calif.

In opening up new areas of the West to agricultural development one of the problems has been to determine which crops and varieties of crops are best suited to each area—a time consuming and expensive procedure. Most crops are sensitive to changes in environment, and a considerable amount of breeding work must be done by state experiment stations or U. S. D. A. scientists to adapt a plant to new surroundings. A remarkable exception to this is the sugar beet. Since recovery of sugar from the sugar beet was placed on an economic basis in the United States—more than 70 years ago—the sugar beet crop almost invariably has been recommended for new areas and is one of the first to be planted in them.

Reasons why the sugar beet seems to fit so readily into the new areas are now becoming known, and are providing a scientific basis for the practical observations of thousands of farmers. To illustrate the unusual adaptability of the sugar beet to climate one needs only to look at the map and note the widespread areas of production. Here in the United States sugar beets were planted in 22 States in 1956. These States range from Ohio in the East to California in the West, and the plantings spread from the Mexican border to the Canadian border. In addition, beets are grown in Canada, many parts of Europe from Sweden to Italy, and on the continents of Africa, Asia and South America.

While it is true that a particular sugar beet variety will show better adaptability to one area over another, many times this is due to disease resistance and not to the basic ability of the plant to produce. In a series of tests run in 1954, sponsored by the Beet Sugar Development Foundation, the industry's research coordinating arm, sugar beets were planted in 17 widely separated locations throughout the United States, under uniform test conditions. While there were differences in yields from these tests, the variation was not nearly so great as the variation in the climates of the widely scattered areas.

Before these tests were run, there was little knowledge available about the reasons for the behavior of the sugar beet as a plant. No one knew just why it was adaptable to many climates. In order to explore this extremely complex phase of plant growth the Beet Sugar Development Foundation worked out a cooperative research project with the University of California and the California Institute of Technology at Pasadena. Pasadena was chosen because the Institute then

CLIMATE ROOM at California Institute of Technology, Pasadena, Calif. Differences in top growth are due to nutrient differences. This room was maintained at temperatures similar to those in the Mountain States area. *Photo by P. B. Smith.*

was just completing the Earhart Plant Research Laboratory, a unique structure with greenhouses and light chambers able to duplicate almost any climate in the world. Here under ideally controlled conditions, length of day and temperatures can be studied without worrying about the unusual weather we always seem to get when trying an experiment in the field.

After 4 years of these tests some of the answers to the growth of the sugar beet began to take shape. It was definitely established that the sugar beet is different from many plants in that it does not have any ripening mechanism. A beet grown under mild temperatures was still growing after 4 years and showing no signs of flowering and producing seed, the final phase of the plant's life cycle. What was normally considered as a mature beet is now known to be the product of environment. Cooler temperatures, shorter days, and changes in nutritional levels are the reasons for the "maturing" of the sugar beet. This characteristic explains much of a sugar beet's ability to produce in many climates.

While these studies were going on another interesting and enlightening development in sugar beet agriculture was taking place quite by chance in California. It was always believed that the crop had to be out of the ground before the heavy winter rains started. However, in the fall of 1950 the rains came early and in heavy amounts, and it was impossible to get a large part of the crop out until the following spring. When the harvest was completed the next spring, yields in tons per acre were substantially higher and the sugar content, percentagewise, was not changed. So quite by accident the beet showed a new side of its character, and the overwintering of beets is now a common practice in the State. Unfortunately, this practice can be carried on only in areas where the winters are mild.

Until now we have mentioned only climate and the adaptability of the beet with respect to widely different climatic conditions. Another and equally important factor is the soil. Most plants will do better on a particular type of soil structure and within rather narrow limits of soil alkalinity or acidity. Here again the sugar beet proves itself a versatile performer. Beets are regularly grown in heavy, adobe soils and nearby on light, sandy loams—and with equal opportunity the results are the same. Here in California some growers plant beets as a reclamation crop in land too high in alkali for crops normally grown in the area. In the delta areas of the state acidity becomes a problem at times and beets are a customary crop in these areas also, seemingly less disturbed by the acidity than other crops. Basic research is already in progress to find the answers as to the beet's ability to thrive under these varied conditions.

With the sugar beet having all these attributes—remarkable adaptability to a wide range of soil and climatic conditions—it is no wonder that the crop has long been the first to be introduced into a new agricultural area. With the excellent work done by the plant breeders in developing disease resistant varieties, the crop has grown with the country and has become an important and essential part of its agricultural economy. # # #

A SUGAR BEET 3½ years old, illustrating the fact that the sugar beet does not have any ripening mechanism.

Ability -- not disability!

In cooperation with the President's Committee on NATIONAL EMPLOY the PHYSICALLY HANDICAPPED week, proclaimed by Hon. Dwight D. Eisenhower October 7–13 we present these typical examples of opportunities the Bureau of Reclamation is offering to handicapped persons.

BARBARA ANN ANDERSON, typist in the Commissioner's Office at Denver, Colorado, recently won a $125 award for "sustained superior performance in all aspects and outstanding accomplishment in production and quality of work." During 10 of the preceding 12 months, her volume of finished work exceeded that of all other typists in the Denver Office!

Yet, Barbara has always had to cope with a serious physical handicap. When only 8 months old, meningitis destroyed her hearing. To compensate for the loss, she became adept at lip reading and even developed speech sufficiently to take part in group discussion. In addition to her outstanding production record, her work habits are rated "excellent" by her supervisor, and her attractive appearance and winning personality have won her many friends among fellow employees.

Barbara is still in her 20's, married, and has a 5-year old daughter. With her husband, similarly afflicted since childhood, she is much interested in social and recreational activities designed to brighten the lives of the deaf.

HAROLD R. HAGAN is employed by the Bureau of Reclamation as Head Draftsman in the Drafting and Reproduction Branch of the Lahontan Basin Development office. He is responsible for the drafting and reproduction of maps and related engineering charts, graphs, and drawings associated with planning and construc-

(A) BARBARA ANN ANDERSON, (B) HAROLD R. HAGAN, (C) DONALD J. WINGE, (D) ANDREW CORTOPASSI.

C. KENNETH HOWE.

tion of Reclamation projects. Mr. Hagan performs his responsibilities in an efficient, thorough, cooperative, and dependable manner despite the loss of his entire sight in one eye as a result of spinal meningitis when 14 years old and the partial loss of his hearing as a result of a shell burst in World War II. He is noted for his humorous cartoons and is affectionately known as the "Walt Disney of Carson City, Nevada."

Mr. Hagan was born November 1, 1915, at Logan, Utah; he owns his own home in Carson City, Nevada, and has three children. He began working with the Bureau of Reclamation as a draftsman in July 1946 on the Uncompahgre Project, Colorado, and transferred to the Fallon area office, Fallon, Nevada, in July 1947 as Engineering Draftsman. He moved to Carson City when the Fallon area office was disbanded in 1951.

DONALD J. WINGE entered on duty with the Bureau at Minot on September 12, 1955. He is afflicted with progressive muscular dystrophy, which affects his arms and legs. The disease was first noticed when he was ten years old and he is now 23. In 1949, the doctor at the head of the medical center at the University of Minnesota estimated that Mr. Winge would lose his ability to walk within six months. However, he is still able to walk along level surfaces but experiences difficulty negotiating stairs which he does laboriously with the aid of a cane. At present, he is in the worst stage of the disease and any new development can only be for the better.

He has completed high school and also three years of study at the University of North Dakota. Since most of his duties can be performed at a drafting table, his physical handicap has had little or no effect on his work and he satisfactorily meets the requirements of his job.

ANDREW CORTOPASSI suffered the loss of his left arm just below the elbow when a T. N. T. land mine accidently exploded during training maneuvers in July 1942 at Fort Lewis, Washington.

Andy subsequently recovered, and after being fitted with an artificial member, was honorably discharged from the service in 1943. Subsequently, he attended Heald's Engineering College in San Francisco, California, and completed the Civil Engineering course in May 1945, gaining his B. S. degree.

Andy continued on with Heald's College as an instructor, and in December 1945, a second disabling accident occurred. This accident, a collision between a cable car and a street car in San Francisco, resulted in Andy's losing his left leg just below the knee. Andy was a passenger in the street car involved.

In January 1947, Andy had recovered sufficiently to become employed with a private concern as a surveyor, performing work in the Central Valley of California.

In April of 1949, Andy received a Probational Appointment with the Bureau of Reclamation as an Engineering Aid. At the present time he is a Construction Management Engineer, working on the Solano Project as a computer in the Contracts and Estimates Branch.

Andy has mastered the use of his artificial left arm and left leg to the point where he even engages in an occasional game of bowling.

C. KENNETH HOWE is employed as Property and Supply Clerk in the Durango Development Office of the Bureau of Reclamation, Durango, Colorado. Mr. Howe is an excellent example of top notch performance of the physically handicapped. The Durango Office has never had this position filled by anyone who has kept a better set of records or carried a heavier work load.

FRANK M. BRYAN.

EDWARD O. LINTZ.

A veteran of World War II, he lost his right arm during action in the Philippine Islands. Normally right handed he had to learn to use his left hand to do more than double duty. Although he wears an artificial limb, a stranger is usually unaware of his handicap and his friends are no more conscious of the fact than if he wore glasses.

Mr. Howe is married and has two children. He leads a full life keeping up with his outdoor hobbies of hunting and fishing. On weekends he heads for the hills in his Jeep or hikes to where the big fish are waiting. During hunting season you can be sure that the Howes have elk and deer meat.

FRANK M. BRYAN, Tour Leader at Friant Dam, as a corporal in a Marine machine gun crew at Okinawa in 1944, was hit by an exploding mortar shell, wounding him on the right side and causing the loss of his right arm above the elbow. For this injury the Purple Heart was added to his several other medals.

In 1946, Mr. Bryan went to work for the Bureau of Reclamation at Friant Dam as an Information Agent Guide. Today, as Tour Leader, he serves the Government well by giving information to tourists at Friant Dam, and guiding schools and other civic groups over the various facilities at Friant Dam. He, in many ways, gives assistance to the Guard Force at Friant. He keeps busy between tours and visitors by growing flowers and shrubs around the Vista House and grounds. This is a point of special interest to tourists and visitors.

Mr. Bryan gained the use of his left hand and arm remarkably well for in his normalcy he was right-handed. His artificial arm was well matched to his right by the Veterans' Administration so that one hardly notices the loss.

EDWARD O. LINTZ was stricken with polio at the age of 3. After initial hospitalization because of the disease, he spent about 4 months in the Shriner's Hospital at Minneapolis, Minnesota, when he was 13 years old, for corrective surgery and therapy. He is partially paralyzed in both legs from the hips down, the left leg being more affected and is about 1¼ inches shorter than his right. He walks with some difficulty, generally with the aid of a cane.

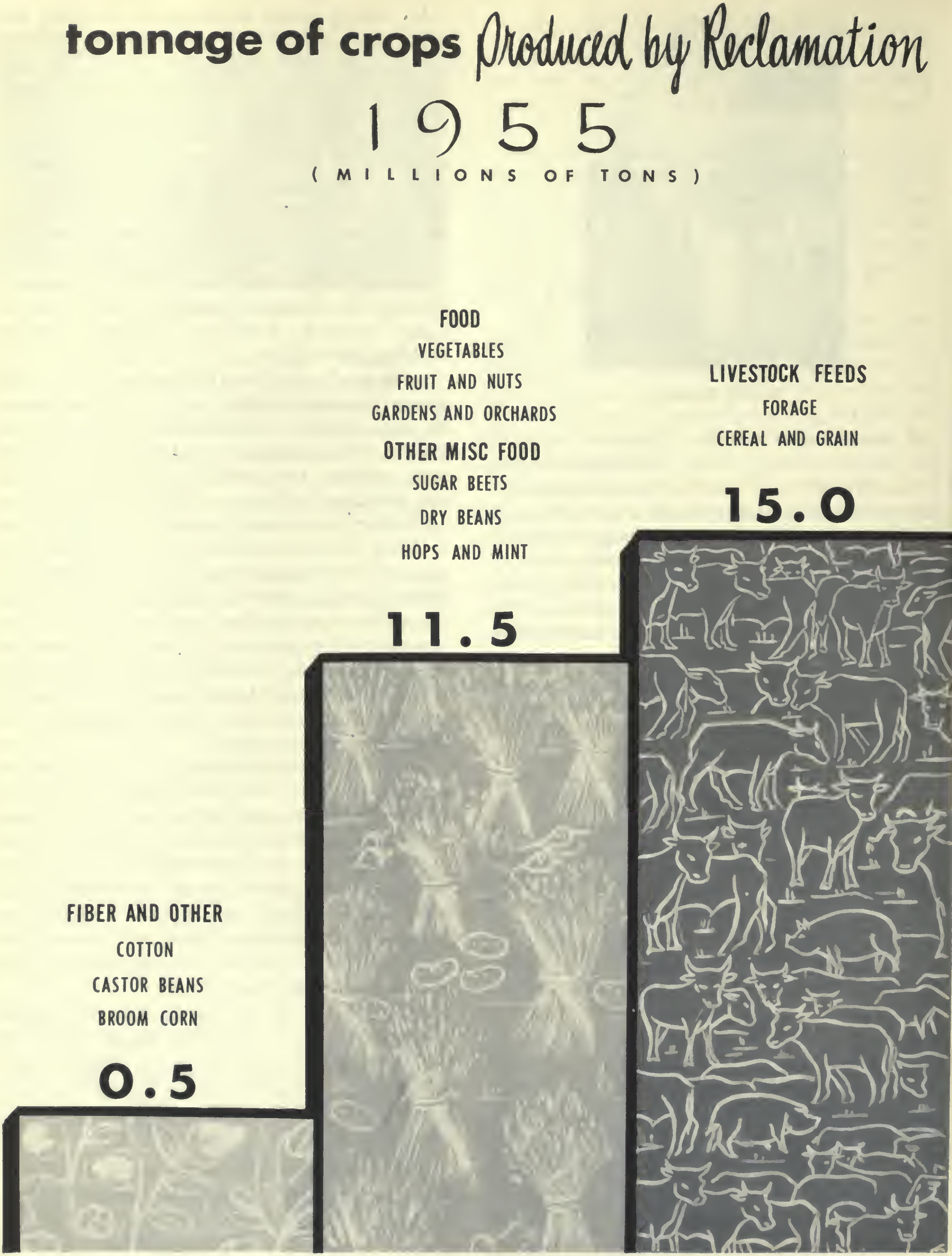
After graduating from high school, he attended Gregg Business College at Twin Falls, Idaho. He then worked as a bookkeeper, salesman, and in various other capacities connected with sales of farm produce, and building materials in Idaho, and Redding, California. He was employed as a Clerk-Typist by the Bureau of Reclamation at Redding, California in 1942. Through his knowledge of building materials and his industrious, dependable and persistent efforts, he was advanced through various positions in connection with procurement of materials for the construction of Shasta Dam until he was appointed Purchasing Agent of the Shasta Operations Field Branch in 1953. He has been performing these duties satisfactorily since that time.

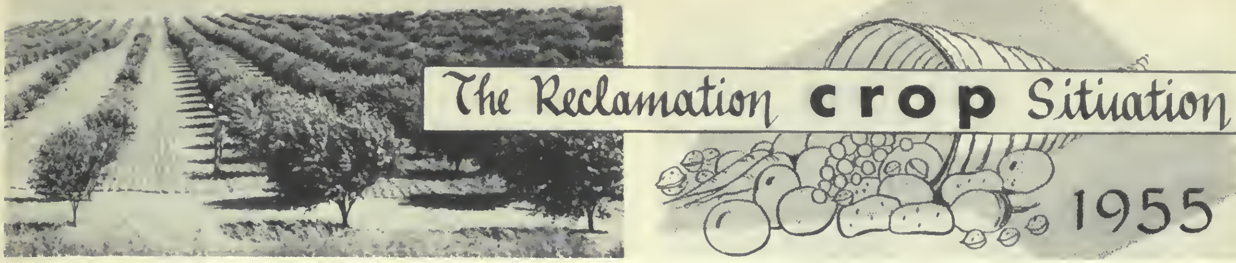
Mr. Lintz is married and has a son and an adopted daughter. Mr. Lintz has owned his home for several years and has performed much remodeling and repair work without additional help.

PRESIDENT EISENHOWER in his proclamation called upon the people of the Nation to observe the WEEK as National Employ the Physically Handicapped Week, and to cooperate with the President's Committee on Employment of the Physically Handicapped.

He also urged the governors of States, mayors of municipalities, other public officials, leaders of industry and labor, and members of religious, civil, veterans', agricultural, women's, handicapped persons', and fraternal organizations to participate actively in this observance.

The observance of National Employ the Physically Handicapped Week each year was authorized by the joint resolution of the Congress approved August 11, 1945 (59 Stat. 530). # # #


tonnage of crops Produced by Reclamation
1955
(MILLIONS OF TONS)
FOOD
VEGETABLES
FRUIT AND NUTS
GARDENS AND ORCHARDS
OTHER MISC FOOD
SUGAR BEETS
DRY BEANS
HOPS AND MINT
11.5
LIVESTOCK FEEDS
FORAGE
CEREAL AND GRAIN
15.0
FIBER AND OTHER
COTTON
CASTOR BEANS
BROOM CORN
0.5



The total harvest from all Reclamation projects in calendar year 1955 was valued as over $827.7 million, an average of $132.18 per irrigated acre. Irrigable lands for service totaled 7,367,735 acres, of which 6,261,761 acres were actually irrigated. As compared to 1954, this represents an increase in irrigation of 135,995 acres.

Forage crops were produced on 52.6 percent of the net area irrigated on all Reclamation projects, and 25.3 percent of the irrigated lands were utilized in producing cereals. The crops within these two groups, totaling more than 14.8 million tons, are utilized principally as livestock feeds, generally in the local areas of production.

Over 5.6 millions of tons of fresh vegetables, fruits, and nuts were produced from more than 719,000 acres of irrigated lands in 1955, and miscellaneous food crops such as dry beans, sugar beets, mint, hopes, etc., totaling over 5.9 million tons were produced from almost 677,000 acres.

The volume of agricultural production totaled over 27 million tons in 1955, an increase of almost 458,000 tons over 1954. Increases were noted for most crop groups. Cereals were up 154,000 tons; forage, 561,000 tons; seeds, 27,000 tons; vegetables, 181,000 tons; and fruits and nuts, 269,000 tons. Miscellaneous field crops were down more than 735,000 tons. The production of cotton was down more than 200,000 bales, sugar beets decreased almost 600,000 tons, and dry beans fell off about 18,000 tons. Average per acre crop yields were slightly higher than in 1954 for the principal crops

DATA on crop production by crop groups follow:

Crop group	Irrigated crops		Gross crop value	
	Acres	Percent of total	Total	Percent of total
Cereals	1, 585, 465	25. 3	$98, 554, 656	11. 9
Forage	3, 294, 765	52. 6	169, 856, 696	20. 5
Field Crops, Misc	1, 119, 288	17. 9	231, 936, 540	28. 0
Seeds	285, 800	4. 6	28, 485, 153	3. 4
Vegetables	458, 901	7. 3	143, 133, 802	17. 4
Fruits and Nuts	260, 463	4. 2	132, 784, 946	16. 0
Other [1]			22, 953, 949	2. 8
Total Reported	7, 004, 682	111. 9		
Less Residue and Multiple Crops	888, 631	14. 2		
Plus Soil Building Crops	145, 710	2. 3		
Net Acres Irrigated	6, 261, 761	100. 0	827, 705, 742	100. 0

[1] Additional revenues from Federal and commercial agencies.

Lush Wheat Crop on Minidoka Project, Idaho-Wyoming, averages 51 bushels per acre.

produced on most Federal irrigation projects, and generally, 1955 was a good crop year.

Average unit prices received by irrigation farmers for their products were generally somewhat lower than in 1954. This was true for all the principal crops except alfalfa hay, lettuce, dry onions, and peaches, which increased slightly in 1955.

The most significant individual crops produced on irrigated project lands in 1955 were barley, wheat, alfalfa hay, pasture, sugar beets, cotton, dry beans, late potatoes, tomatoes, lettuce, carrots, sweet corn, apples, peaches, table grapes, and citrus fruits.

The 73 Reclamation irrigation projects, located throughout the 17 Western States, are divided into 7 regions for administrative purposes. States located mainly within each region are as follows: Region 1—Washington, Oregon, Idaho, and Western Montana; Region 2—California, except southern portion; Region 3—Arizona, Southern California, and Southern Nevada; Region 4—Nevada, Utah, Western Colorado, and Southwestern Wyoming; Region 5—Texas, New Mexico, Oklahoma, and Southern Kansas; Region 6—Eastern Montana, North Dakota, South Dakota, and Northern Wyoming; Region 7—Eastern Colorado, Nebraska, Northern Kansas, and Southeastern Wyoming.

Region 1, with 2,229,614 acres of irrigated lands, the largest in area irrigated of the seven Bureau Regions, produced crops valued at over $242 million. This Region contains 36 percent of the irrigated lands and accounted for 29 percent of the total value of crops produced on all Reclamation projects in 1955. Region 3, with less than half as much irrigated land as Region 1, produced crops valued at almost $213 million, or 26 percent of the total production from all Federal projects during this same year.

Comparative data for Regions follow:

Region	Irrigated acres		Gross crop value	
	Acres	Percent	Total	Perce
			(Dollars)	
1	2, 229, 614	36	242, 676, 213	29
2	869, 765	14	184, 086, 738	22
3	911, 397	15	212, 984, 713	26
4	543, 421	9	39, 502, 914	5
5	261, 536	4	45, 921, 093	6
6	469, 803	7	20, 013, 649	2
7	976, 225	15	82, 520, 422	10
Total	6, 261, 761	100	827, 705, 742	100

Each of the 17 Western States participated in the Reclamation harvest for 1955. Idaho had a larger acreage of irrigated project lands than any of the other States, followed by California, Colorado, Washington, Oregon, Arizona, Nebraska, Utah, and Montana. The gross value of crops produced on Federal projects located in California was higher than for the other Western States; however, the average gross crop value per acre was highest for Arizona, followed by California, Texas, Washington, New Mexico, Oklahoma, etc., respectively.

The irrigated acreage and crop value data are presented for each State.

Harvesting Idaho Netted Gem Potatoes on the Boise Project located in Idaho-Oregon. ***Photo by Tillery.***

a lifetime of RECLAMATION

by JESSE R. THOMPSON

I was born in Shelby County, Missouri, on February 6, 1891. My folks moved to Montrose, Colorado, before I was a year old. Here I grew up, attended grade school and high school until I was in my senior year, when I quit to go to work. I had worked in the summers and after school since I finished grade school.

My father was Superintendent of the Cimarron Ditch for several years and I worked part of the time for him. Then he went to work for the Bureau of Reclamation as a Foreman and on April 4, 1909, I went to work for him on the Uncompahgre Project as a teamster. The work was usually too far from home to drive back and forth and we usually stayed at some farm house, boarding with the farmer. We had our own bed rolls and slept in the bunkhouse or shed. When team work was not necessary, I worked at carpentry work, building and repairing structures of pick and shovel work as required.

I quit in the fall and took a course in bookkeeping at Hoels Business College in Montrose. I finished my course in the spring about the time work started on the Cimarron Ditch. Inasmuch as my chum worked there and a job was offered to me, I went back to work on the Cimarron Ditch.

I came down to Montrose in June and went back to work on the Uncompahgre Project, taking the same job I had the summer before. On July 6, 1910, I was appointed patrolman on the South Canal. The canal was built to carry water from the Gunnison Tunnel to the Uncompahgre River. I followed the first water that ran from the Gunnison Tunnel through the South Canal to the Uncompahgre River. I patrolled the canal at night throughout the irrigation season.

My wife and I were married in October of 1910. The following winter I worked on the construction of a new headgate on the Loutsenhizer Canal at its headworks on the Uncompahgre River. Before the headworks were completed, I was put in charge as foreman.

After completion of the Loutsenhizer headgate, we were transferred to Camp 4 on the South Canal

Smoothing old floor of Gunnison Tunnel with new layer of concrete—1940.

where I held the position of Ditch Rider up to June 15, 1913.

It was about this time, through the encouragement of Mr. F. D. Pyle, Project Manager, that I enrolled in a course of Civil Engineering with the International Correspondence School of Scranton, Pennsylvania. It took me from 10 to 12 years to complete this course, doing all my studying in the morning so as to spend my evenings with the wife and children. I usually got up at 4 a. m., and made it a point to study at least 1 hour every day except Sunday regardless of how I felt.

On June 16, 1933, I was appointed Assistant Water Master in charge of the South Canal and several other laterals. On November 14, 1917, I was appointed subforeman to supervise concrete work in the Gunnison Tunnel. When spring came, I was sent back to my job as Assistant Water Master which I held until January 20, 1919, when I was appointed Foreman to supervise the building and placing of irrigation structures.

During the winter of 1920 and 1921 I was oiler on a dragline on the project. In the spring I was back on the foreman's job and kept at this work up to December 31, 1931.

On January 1, 1932, when the Uncompahgre Project was taken over by the Uncompahgre Valley Water Users Association, I was appointed Hydrographer and Water Master.

I was reinstated with the Bureau of Reclamation and moved to Boulder City, Nevada, on the Hoover Dam Project, as city foreman, on March 30, 1933. After 14 months at Boulder City, I was advised by our doctor that I would have to take my youngest daughter out of the desert. Mr. C. B. Elliott, Uncompahgre Project Manager at the time, informed me that a job was waiting for me.

I went back to work as Water Master for the Association on May 21, 1934, and was appointed as Acting Superintendent on the Uncompahgre Project on October 1, 1934.

On October 19, 1937, the duties of Treasurer were added to my position and I was Acting Superintendent and Treasurer.

On March 21, 1938, I was appointed Manager-Treasurer of the Association, which position I recently resigned to become effective July 1, 1956

Top right: UPPER UNCOMPAHGRE VALLEY near South Canal, 1917. Center right: irrigated hay fields with canal and desert in foreground, Uncompahgre Project, 1942. Lower right: J. H. Quinton (left), Supervising Engineer, and C. J. Blanchard, Statistician at west portal of the Gunnison Tunnel in 1909.

Water Report

by HOMER J. STOCKWELL

Snow Survey Supervisor, Soil Conservation Service, Fort Collins, Colorado

and

NORMAN S. HALL

Snow Survey Leader, Soil Conservation Service, Reno, Nev.

WEST CANAL WATER WENDING its way to fertile and productive lands of the Columbia Basin Project, Wash. *Photo by Stan Rasmussen, Region 1.*

Irrigation water supply in Western United States during 1956 varied from more than adequate in the Pacific Northwest to a continuation of drouth conditions over much of the Southwest and the Southern Rocky Mountain region. The water supply followed that indicated by mountain snow cover in the spring of this year. Plans to fit water use to the amount of water available were extensively adopted over the West early in the season. In the Northwest where the heavy snowpacks existed, reservoirs were lowered early in the spring and other control measures were instituted to minimize damage from high water during the peak of snowmelt. In the drouth areas substantial changes in cropping practices were made to coincide with the storage of water supplies. The development of groundwater for irrigation was extended over a wider area and more intensively used than in previous dry years.

This analysis is again presented in the *Reclamation Era* through the courtesy of the authors, and *Mr. R. A. Work*, Head, Water Supply Forecasting Section.

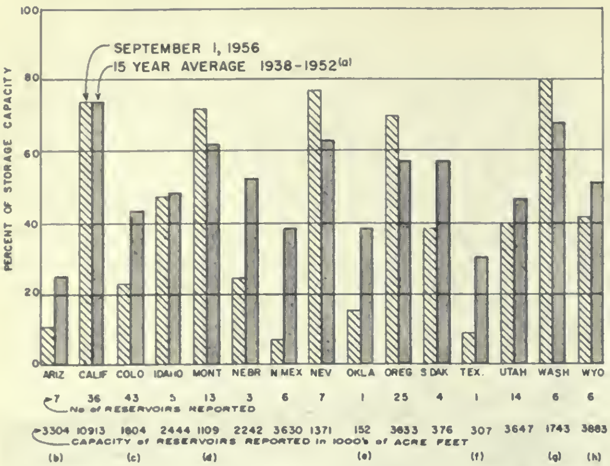
A brief west wide summary of snow conditions and water supply outlook prepared by the Water Supply Forecast Section, Soil Conservation Service, was published in the May 1956 issue of RECLAMATION ERA.

Summer rainfall was deficient over most of the west except for the northern tier of states. This caused more than usual demands on water supplies, particularly where water was short.

The drouth of the southwest, including the states of New Mexico, Arizona and parts of southern California, Nevada, Utah and Colorado, which has been severe for several years, extended further into Colorado and Utah. A shortage of water has existed for a long time, up to almost fifteen years in Arizona. Irrigated areas of Arizona and New Mexico have come to depend largely on pumps for the main source of water. In the past few years pumping has been rapidly increasing in importance in the San Luis Valley and along the Arkansas and South Platte Rivers of Colorado. In these areas it will take several years of above normal runoff to recuperate from the years of drouth. With increasing water demands, the conservation and development of water that may be available is becoming more important.

In Colorado, water supply was short except for areas in the northwest part of the state and on the South Platte where supplemental water was available from the Colorado-Big Thompson project. In practically all irrigated areas of New Mexico and Arizona, water conditions at the present time are probably the poorest of record. Reservoir storage is exhausted and groundwater tables continue to lower. Southern Utah experienced extreme water shortage especially in the Sevier River. Storage water and streamflow provided fairly good supplies for central and northern Utah. Heavy fall rains and heavy snowpack during last winter resulted in satisfactory water supplies for the Central Valley of California and western Nevada with no damaging high water. Southern California continues to depend on imported water from the Colorado River and Owens Valley.

Streamflow over the northwestern states of Oregon, Washington, Idaho and Montana was



well above normal in 1956. Minimum damage from high flows was experienced, due to advanced planning by reservoir control and flood control work. Shortage of water occurred only on a few local streams which receive a limited amount of water from high mountain watersheds. Reservoir storage in all of these states including Nevada is 110 to 120 percent of normal. The outlook for 1957 water is good if average snowfall occurs during the winter months. Water supplies in Wyoming were adequate for demands during 1956. Except for a few areas on the North Platte in Wyoming and Nebraska, necessary water was supplied from carryover storage. Storage is now among the lowest of record.

The water supply outlook for 1957 as of this time is generally good for the northern half of the west and exeremely poor for the southern half.

Fall soil moisture conditions follow the pattern of water supply for this year. In the north, average snowpack will generally be sufficient to assure water supplies for next year. In the south, well above average snowpack will be required to provide even a reasonable supply because of low carryover storage and dry soils.

In the following paragraphs there is reported a summary of fall water conditions by states. A chart showing status of reservoir storage and a map of water conditions summarize the outlook at the end of the 1956 irrigation season.

ARIZONA—Unusually low summer precipitation in Arizona resulted in marked decreases in present water supplies. Reservoir storage has decreased from a year ago because of increased demand due to low rainfall and from less than normal runoff. On the Salt River Valley Project the stream flow from January through August was about 40 percent of normal. Net storage on the project as of September 10 was 180,000 acre-feet, the lowest in recent years. There will be very little carryover for the next season.

Shortage of water in Arizona has continued for several years with no improvement in sight. Demand has exceeded supply for 15 years.

The present outlook for next year is poor. Mountain soils are dry. Unless there are heavy fall rains and above average snow pack during the winter months, the agriculture and general economy of the state will be adversely affected next year.

CALIFORNIA—The California Department of Water Resources reports that water conditions during the spring and summer months of 1956 proved entirely satisfactory in most areas of California. At the time of the unusually heavy precipitation, which caused northern California's disastrous floods of December 1955, an extremely heavy snowpack was deposited at the higher elevations in the Sierra Nevada and Cascade Range. The late winter precipation was very light and the spring precipitation only normal in the Central Valley area. However, the snowmelt runoff during the April-July period was approximately 129 percent of normal due primarily to the above-normal high-elevation snowpack. Snowmelt runoff did not pose any serious flood threat during the spring season.

High water during December and the above-normal spring runoff assured an adequate water supply in most areas north of the Tehachapi Mountains. As of September 1, 1956, the storage in 36 major reservoirs serving the Central Valley was approximately average (1943–52) for this date at 74 percent of capacity. Storage as of September 1, 1956, was 3,000,000 acre-feet greater than that of the same date of 1955.

Winter precipation south of the Tehachapi Mountains was in general very light, being only 35 to 40 percent of normal in most areas. Although spring precipitation was above normal, only water from the Colorado and the Owens Rivers averted the perennial water shortage problem in this area.

COLORADO—Irrigation water supply in most of Colorado was short for the 1956 season. Crop reductions in both acreage and total production was noted in every major watershed. The only exceptions to this general shortage were areas which divert water directly from the main stems of the Yampa, White and Upper Colorado rivers in northwestern Colorado. The Colorado Big-Thompson project provided good supplemental water supplies for the northern tributaries of the South Platte. Storage remaining on the project is almost 250,000 acre-feet which was better than expected. Except for isolated areas of thunderstorms, the whole state was dry through the summer and fall months. Streamflow that materialized was less than indicated at the end of the snow season of 1956.

An extensive increase in pumping is reported for the irrigated areas of the South Platte, Arkansas and the Rio Grande. This follows a pattern of the past three or four drouth years.

Reservoir storage for irrigation is practically exhausted which has been the case for the past two years. Even where streamflow was relatively good there was little opportunity to store water because of direct flow demand during the peak of snowmelt.

Soils in both mountain and valley areas are dry. Snowfall during the winter months will have to be well above average and precipitation normal or above next summer to provide an adequate water supply for next season.

IDAHO—Snow surveys early in the winter of 1956 indicated a heavy streamflow for all of Idaho and Columbia Basin. The water supply outlook was good south of the Snake River and excellent throughout the rest of the state. Heavy snowfall continued through the winter and dangerously heavy flows were forecast for all of northern Idaho. Unprecedented work and operational plans were put into effect by the Corps of Engineers and the Bureau of Reclamation to control the high flow during the spring snowmelt. Damaging high flows did occur on the Kootenai, Coeur d'Alene, Spokane, and smaller northern rivers. Destruction, however, was held to a minimum by the completion of dikes and other structures before the rivers began to rise.

Southern Idaho, which has had several low water years in a row, had a good irrigation season with better than

(Continued on page 108)

IRRIGATION CHIEF RETURNS FROM THE NETHERLANDS

Floyd E. Dominy, the Bureau's Chief of the Division of Irrigation, recently returned from The Netherlands where he has been conferring with officials of that Government on Reclamation development and land reapportionment.

Mr. Dominy, at the invitation of The Netherlands Minister of Agriculture, Fisheries and Food, spent 2 weeks in The Netherlands for the purpose of exchanging ideas and consulting with The Netherlands Government officials on matters involved in the subjugation of lands to irrigation, establishment of optimum size of farm units, and the selection of settlers. During the conferences with The Netherlands officials he also advised on the type of assistance required for settlers in the early stages of reclamation development, and the mechanics of determining project repayment in accordance with the principle of ability to pay.

During the past 5 years Professors Eysvoogel and Hellinga of the Agricultural University of Wageningen, The Netherlands, as well as Doctors Herweyer, Pijls, Visser and Van den Berg, all of The Netherlands Reclamation Service, have been studying Reclamation project developments in the United States. On many of these visits to the United States The Netherlands officials had occasion to consult with Mr. Dominy whom they found thoroughly informed and most helpful on Reclamation problems.

It was on the recommendation of these gentlemen that the Minister of Agriculture, Fisheries and Food extended the invitation to Mr. Dominy to visit The Netherlands.

Mr. Dominy, a graduate of the College of Agriculture, University of Wyoming, has had over 25 years experience in the field of irrigation development. #

New Reclamation Accomplishment Report Available

At the request of the Chairman of the House Interior and Insular Affairs Committee, Commissioner W. A. Dexheimer announced the availability of a new report in the series of Reclamation Accomplishments, published by the Committee.

The latest report is entitled "The Contribution of the All-American Canal System to the Economic Development of the Imperial-Coachella Valleys, California, and to the Nation." For convenient reference in ordering copies, the short title of the report "Committee Print No. 13" may be used. Copies may be obtained by writing to your nearest Regional Director. For addresses consult the back cover of the *ERA*.

E. C. FINNEY DIES

E. C. Finney, 86, a former Department of the Interior aide for 39 years and Washington lawyer, died recently after a short illness.

Mr. Finney was a native of Milton, Pa., and a District resident since 1894. He was graduated from the University of Kansas Law School in 1891 and received the degree of doctor of laws from Howard University early this year.

Mr. Finney joined the Department of the Interior as a clerk in the General Land Office in 1894 and reached the post of assistant Secretary of the Interior in 1909.

Served Under Harding

Under President Harding he served as first assistant Secretary of the Interior and continued in that post until 1929, when he was appointed solicitor for the Department, a post he held until 1933.

Although he returned to private life that year, he was often called upon to help draft legislation on public land law.

NEBRASKA-BOSTWICK DEDICATION

Board of Directors for the Nebraska-Bostwick Irrigation District meet with the Hon. Fred G. Aandahl, Assistant Secretary, Department of the Interior, during the recent dedication, in Red Cloud, Nebr., of the Bostwick Division of the Missouri River Basin Project.

Left to right: Ben Harrington, Secretary; Blaine Lyons, Director; Halbert Thomas, Chairman and Mr. Aandahl. Photo by Lyle C. Axthelm, Region 7, Bureau of Reclamation, Denver, Colo.

THE EDITOR'S COLUMN

The following facts have been gleaned from the United States Department of Agriculture's Agricultural Situation, dated August 1956. We hope that you find them helpful.

What Kind of Meat Are You Producing?

Do livestock producers make more money by trying to please the housewife who buys their beef, pork, veal, and lamb?

Do their customers, the consumers, prefer beef from heavy or medium weight cattle? The top or medium grades of beef? What is the trend in production of meat?

The housewife-shopper's wishes and preferences, her likes and dislikes, definitely have much to do with the kind of product that can be produced and sold with most profit. They must be harkened to.

The consumer of today is quality-conscious. We can't examine here all her wants and wishes. We can stress that she is sensitive to quality, and that she insists on uniformity and dependability.

In the future, consumers can be expected to insist even more on uniform, reliable quality, and to be receptive to new products of high quality.

Pork producers will be hard pressed to maintain their place with beef, but with the aid of an improved, meatier pork, may be able to do so.

Even more cattle will be fed, and in year-round programs, but not quite to so high finish as in the past.

Probable weights of cattle are more of a puzzle. Heavy beef carcasses have incurred price discounts, yet producers prefer to raise a fairly sizable animal that can take lots of feed. For the near future, weights may be no more than moderately heavy. Later, changes in merchandising and cutting could relieve some of the objections to heavy weight.

New Methods

Two new forms of handling meat that are now under study and development could have great effects on the kind of meat supplied to consumers. They are quick freezing and irradiation. Both would reduce perishability, permit cutting and packaging at the packing plant, and have several other consequences. Their widespread adoption is at least several years off. They are, for now, something to think about.

But right now, let's see how some of the past trends in livestock and meat match the present preferences of consumers.

The outstanding trend in production of meat is the increase in supply of beef relative to pork. From 1920 to 1929, the average consumption of beef per person was 56 pounds. Last year it was 81 pounds. In 1920–29, consumption of pork was 67 pounds. Last year it was no larger. In fact, it was a little less—just 66 pounds.

It would be wrong to ascribe all this relative increase in beef to the influence of consumer demand. However, with little question, demand for beef has outrun that for pork.

In the 1920's, when many beef steers were sold as 3-year-olds or older, cattle slaughtered under inspection averaged 961 pounds. Weights decreased in the 1930's, but have increased since. Weights of calves, lambs, and hogs have generally increased, though hogs are not as heavy now as during the war.

Exports

The value of agricultural exports for the year ending June 30, 1956, is estimated at about 10 percent above the previous year. For calendar

1956, a substantially larger increase is expected. This is based on a resurgence of cotton exports (CCC sales for export after August 1 now total 2½ million bales) and continued high exports of most other commodities.

In addition to the improved ability of major foreign countries to pay for United States commodities, United States Government export programs, including CCC sales at competitive prices, assure that neither lack of financing nor high prices will be a deterrent to exports.

CROPS

(Continued from page 100)

IRRIGATED ACREAGE AND CROP VALUE DATA

	Projects or major divisions	Irrigated acreage	Gross crop value	
			Average per acre	Total
	Number	*Acres*	*Dollars*	*Dollars*
Arizona	4	376,703	252.44	95,096,742
California	6	1,283,801	227.96	292,656,693
Colorado	9	788,802	81.58	64,353,829
Idaho	8	1,388,198	84.95	117,926,284
Kansas	1	2,385	51.50	122,821
Montana	11	260,307	43.55	11,336,850
Nebraska	4	279,583	90.25	25,233,732
Nevada	3	96,444	61.90	5,970,247
New Mexico	5	148,911	173.07	25,771,465
North Dakota	4	26,343	55.81	1,470,249
Oklahoma	1	42,847	110.10	4,717,599
Oregon	12	397,492	91.37	36,320,008
South Dakota	3	70,204	40.68	2,855,699
Texas	2	69,778	221.16	15,432,029
Utah	9	270,187	74.53	20,136,697
Washington	3	547,167	177.74	97,251,253
Wyoming	4	212,609	51.99	11,053,545
Total	89	6,261,761	132.18	827,705,742

IDEAS WANTED

Have you a good idea on a short cut or labor-saving device to share with other water users on Reclamation projects? Send it in to the Editor, *Reclamation Era*, Bureau of Reclamation, Washington 25, D. C. The writing does not have to be fancy. Just make certain you have the answers to Who, What, Where, When, Why, and How in your story. As for pictures, a rough sketch or snapshot would serve the purposes. Remember, this is the only official publication of the Bureau of Reclamation, the only periodical devoted entirely to the interests of water users on projects served with facilities made available by the Bureau. It is your magazine, and will be as good as you can make it. By helping others you will also help yourself. Send your item in today.

HOOVER DAM'S 6,000,000 th VISITOR

Boulder Canyon Project Manager L. J. Hudlow, presents photograph album to the six millionth visitor to tour Hoover Dam, MISS CLARA HOFFMAN, 6815½ Fishburn Avenue, Bell, Callifornia. They are shown here atop the dam on the Nevada side. The album contained a variety of pictures of the dam. This photo and others taken of Miss Hoffman during her tour of the structure, were later added to the album. Miss Hoffman purchased the ticket for the 6 millionth tour at 8:40 a. m. on June 30, 1956. A retired public health nurse, Miss Hoffman served 14 years with the Bureau of Indian Affairs in Utah. Miss Hoffman was hosted by Boulder City merchants during her one day stay here and presented with many valuable prizes and souvenirs by public-spirited merchants. (Bureau of Reclamation photo by Fred S. Finch.)

Do You Know . . .

The following records were established in placing concrete on various Bureau of Reclamation projects:

	Size and numbers of mixers	Maximum cubic yards per— 24-hour day	Month	Year
Boulder Dam	8—4 cu. yd.	10,417	261,874	2,563,875
Grand Coulee Dam	8—4 cu. yd.	20,684	509,467	3,663,973
Hungry Horse Dam	5—4 cu. yd.	9,000	233,842	1,371,030
Shasta Dam	5—4 cu. yd.	11,790	222,065	2,266,340

WATER REPORT

(Continued from page 104)

average carryover for next year. Reservoir storage is considerably better than reflected in the chart for Idaho because of four new reservoirs which do not have long enough records for comparative use. They are the Palisades on the upper Snake River, Cascade on the Payette River, and Anderson Ranch and Lucky Peak on the Boise River.

The water supply outlook for next year looks very good on rivers with storage such as the Boise, Payette, and Snake, but the smaller southern tributaries of the Snake are subject almost entirely to the snowpack and spring rains of the individual year.

KANSAS—The shortage of water in the Arkansas River continued into the valley of western Kansas. Precipitation during the summer was less than normal. Storage in Cedar Bluff reservoir on the Kansas River was 130,000 acre-feet on September 1, 1956 but facilities for irrigation have not yet been developed.

MONTANA—Above median streamflow has been experienced throughout the Continental Divide areas of the State during the spring and summer months. The plains area east of the mountains has experienced a shortage of water, especially the dry land farming areas. Drouth and disaster areas were designated in the east central part of the State.

Precipitation has been far below average during June, July, August and September throughout the eastern half of the state and a very serious drouth condition exists on the range lands.

Snowmelt runoff was very close to the volumes forecasted early in March and April. Irrigation water was generally plentiful during the season.

Reservoir storage has remained above average during the summer and at the present time is ten percent greater than the average for September 1.

NEBRASKA—Natural streamflow and precipitation were among the lowest of record in western Nebraska along the Platte. Carryover storage in Pathfinder reservoir in Wyoming provided adequate water supplies for good crop production. Storage in Kingsley provided for similar water conditions for the lower section of the North Platte irrigated area of central Nebraska.

Storage in both the North Platte reservoirs in Wyoming and Kingsley in Nebraska are both critically low, with about one-half of the usual carryover. Local rainfall and heavy snow on the Platte watershed are needed to assure the water supply in 1957. The total water picture is the poorest for several years.

NEW MEXICO—Streamflow in the Rio Grande and its tributaries during 1956 was among the lowest of record. This continues a drough condition which has been very severe over the past four years. Ground water had already been extensively used before this year. Reservoir storage on the Rio Grande is the lowest of record. Water supply conditions on the Carlsbad project were good due to carryover storage which is now exhausted. The flow of the Pecos has been extremely low.

Water supply for the Arch Hurley Conservancy District in eastern New Mexico has been fair to good with limited streamflow. Storage in Conchas reservoir is 87,000 acre-feet for irrigation which is relatively low for this reservoir.

As with other areas of the southwest, the need for heavy snowfall in the mountains during the winter months is evident. It will take several years of above normal runoff to recuperate from this extended drouth.

NEVADA—In western Nevada carryover reservoir storage to meet next year's irrigation season is the best since 1952. Above normal streamflow, as forecasted early in March and April, has kept western Nevada reservoirs nearly full all summer. Typical of this condition are the reservoirs on the Walker rivers. In Bridgeport and Topaz reservoirs, the carryover storage is one of the best on record.

Lovelock Valley, served by Rye Patch Reservoir on the lower end of the Humboldt River, ended this irrigation season with carryover storage of about 40,000 acre-feet. Although this is about half the normal carryover for this reservoir, it is better than the nearly empty reservoir at the end of irrigation season last year. Wild Horse Reservoir on the Owyhee River, in northern Elko County, stored about 150 percent of its September 1, 1938–52 average.

In contrast, the southern part of the State has been suffering under drouth conditions all summer. Below normal precipitation last winter and spring made range conditions poor this past summer. Ranchers in this area have reduced their livestock to meet poor winter feed conditions. Unless above normal precipitation and snowfall occur this winter, ranches in the southern third of the State will face another drouth next spring.

The state-wide picture of reservoir storage as of September 1 is 77 percent of usable capacity or 119 percent of the September 1, 1938–52 average. Last year at this time reservoir storage was only 35 percent of usable capacity. All important reservoirs are in the northern and western portions of the State. These areas end this irrigation season with the best carryover storage since the big snow year of 1952.

OKLAHOMA—The water supply for the W. C. Austin project near Altus was below normal for 1956. Rainfall on the irrigated areas and streamflow into the reservoir were deficient. Crop production has been severely curtailed.

OREGON—The irrigation season of 1956 in Oregon, contrasting with the serious water shortage of last year, has been one of abundant to satisfactory water supplies except on some smaller streams which are not tributaries with high elevation watersheds.

Spring and summer streamflow has generally equaled or slightly exceeded the much-above-average flows predicted last April.

Water storage in most Oregon reservoirs is currently well above the usual amount of carryover held for the following season. Present storage in 25 reservoirs is 123 percent of the average (1938–52) compared with last season when it was 66 percent of average.

Watershed soils are generally average to a little above average in moisture content. Coupled with normal fall rains and an average mountain snow-cover, water supplies for next season should be satisfactory.

TEXAS—The irrigated area of west Texas along the Rio Grande was again short of water because of low stream flow and lack of reservoir storage in Elephant Butte reservoir in New Mexico. Pumping has been on the increase. Crop acreage during 1956 was again extensively reduced. Shortages of water also occurred along the Pecos with a material reduction in crop acreage this year. Storage in Red Bluff Reservoir is down to 27,000 acre-feet, only a small fraction of normal.

UTAH—The drouth of the past several years has continued unabated in most of southern Utah during the 1956 irrigation season. Deficiencies have been particularly severe along the Sevier River. Here, in anticipation of water shortages which were forecast last spring, acreages planted to crops such as sugar beets, which require late season water, were reduced. Some acreage has had to be abandoned and on the remainder, crop yields will be below average.

The outlook for next year's water supply is not good for users in central and southern areas who are dependent on carryover reservoir supplies. Inflow to the reservoirs during the winter is expected to be below average. On September 1, there was a combined total of only 2,800 acre-feet of water in Otter Creek, Piute and Sevier Bridge reservoirs. This compares with an average of 136,700 acre-feet during the years of 1938–52. On the Beaver River, the Rocky Ford Reservoir is dry. By the end of the irrigation period, there will be no carryover storage in any of these reservoirs. The coming winter's snowpack

will have to be much above average for next year's water supply to be satisfactory.

In central Utah, in both the Great Basin and the Colorado River drainage, there has been some shortage of late water, but in general it has been better than a year ago. In Utah County, although natural streamflow has been below average, good carryover storage from previous years has met the needs of most farmers.

Northern Utah has had good water supplies. However, there has been some minor shortage of late irrigation water in Davis County and also in Rich County along the Bear River. Flow on the northern tributaries of the Bear River in Wyoming and Idaho has held up very good.

WASHINGTON—Water supply for irrigation and power has been very good in 1956. Streamflow has been well above average during the five months, April through August, with record high flows occurring at some station every month. Damage from high water was kept at a minimum on streams partially or wholly regulated by reservoirs. Irrigation reservoirs operated by the Bureau of Reclamation on the Yakima River were lower prior to the spring runoff as a result of snow surveys and resultant water supply forecasts. Subsequent inflow and reservoir regulation enabled the Bureau to maintain a river flow at flood stage and thereby keep damage at a minimum.

The status of reservoir storage as of September 1, 1956 is 112% of the long term 1938–52 average and very close to the storage of last year.

Precipitation throughout the State has generally been above normal this summer with the greatest plus departures coming in May and August. Temperatures were well above normal during the month of May, this with high precipitation resulted in the many record high flows experienced during the month.

WYOMING—Water supply in Wyoming for 1956 ranged from more than adequate in northwestern Wyoming to marked shortages along the North Platte, Powder and Belle Fourche basins. Precipitation throughout the state was below normal for the summer period. Storage on the North Platte declined sharply due to demands. Shortages were severe in the Wheatland district. Heavy snowpack over the North Platte watershed and the Big Horn mountains will be necessary to provide adequate water supplies in 1957. The outlook for next year on the Snake, Green and Big Horn is good if the winter snowpack is near normal.

NOTES FOR RESERVOIR CHART

Reservoir storage as of September 1, 1956. Explanation: (a) Most states report averages for reported reservoirs for the period 1938–52, but in a few cases reservoirs with shorter records have been included. (b) Does not include Lakes Mead, Havusu or Mohave (combined capacity 29,700,000 acre-feet); September 1, 1956 combined storage about 15,000,000 acre-feet. (c) Does not include John Martin Reservoir (capacity 655,000 acre-feet); September 1, 1956, storage zero; or Granby, Horsetooth and Carter Lake of the Colorado-Big Thompson Project, (combined usable capacity 725,000 acre-feet); September 1, 1956 combined storage 250,000 acre-feet. (d) Does not include Fort Peck Reservoir (capacity 19,000,000 acre-feet); September 1, 1956 storage 5,739,000 acre-feet; or Canyon Ferry (capacity 1,846,000 acre-feet); September 1, 1956, storage 1,490,000 acre-feet; or Flathead Lake (capacity 1,791,000 acre-feet); September 1, 1956 storage 1,794,000 acre-feet; or Hungry Horse (capacity 3,500,000 acre-feet; September 1, 1956, storage 3,457,000 acre-feet; or Tiber Reservoir (capacity 1,316,000 acre-feet); September 1, 1956 storage 633,000 acre-feet. (e) W. C. Austin Reservoir. (f) Red Bluff Reservoir on Pecos River. (g) Does not include Roosevelt Lake (capacity 5,072,000 acre-feet); September 1, 1956 storage 5,221,000 acre-feet; or Grand Coulee equalizer (capacity 762,000 acre-feet); September 1, 1956 storage 764,000 acre-feet. (h) Does not include Boysen Reservoir (capacity 560,000 acre-feet); September 1, 1956 storage 525,000 acre-feet.

Water Stored in Western Reservoirs

Operated by Bureau of Reclamation or Water Users except as noted

Location	Project	Reservoir	Storage (in acre-feet)		
			Active capacity	Aug. 31, 1955	Aug. 31, 1956
Region 1	Baker	Thief Valley	17,400	(1)	(1)
	Bitter Root	Lake Como	34,800	13,400	8,300
	Boise	Anderson Ranch	423,200	289,600	375,100
		Arrowrock	286,600	45,600	29,200
		Cascade	654,100	232,800	356,600
		Deadwood	161,900	86,200	129,000
		Lake Lowell	169,000	10,300	37,400
	Burnt River	Unity	25,200	400	7,900
	Columbia Basin	F. D. Roosevelt	5,220,000	5,158,000	5,221,000
		Equalizing	761,800	638,900	764,500
		Potholes	513,000	93,000	174,800
	Deschutes	Crane Prairie	55,300	19,000	32,000
		Wickiup	187,300	23,000	115,000
	Hungry Horse	Hungry Horse	2,982,000	2,980,400	3,011,100
	Minidoka	American Falls	1,700,000	557,100	867,200
		Grassy Lake	15,200	11,200	14,600
		Island Park	127,200	49,700	83,500
		Jackson Lake	847,000	358,700	527,300
		Lake Walcott	80,000	96,600	94,000
	Ochoco	Ochoco	47,500	6,500	27,900
	Okanogan	Conconully	13,000	8,700	8,500
		Salmon Lake	10,500	10,200	10,400
	Owyhee	Owyhee	715,000	116,900	468,300
	Umatilla	Cold Springs	50,000	14,600	11,100
		McKay	73,800	17,400	20,300
	Vale	Agency Valley	60,000	0	21,000
		Warm Springs	191,000	0	104,900

Water Stored in Western Reservoirs—Continued

Operated by Bureau of Reclamation or Water Users except as noted

Location	Project	Reservoir	Storage (in acre-feet)		
			Active capacity	Aug. 31, 1955	Aug. 31, 1956
Region 1—Continued	Yakima	Bumping Lake	33,700	14,400	17,400
		Cle Elum	436,900	307,500	309,100
		Kachess	239,000	183,900	186,900
		Keechelus	157,800	102,400	76,600
		Tieton	198,000	143,500	148,500
Region 2	Central Valley	Folsom	920,300	142,000	560,300
		Keswick	20,000	19,200	19,200
		Lake Natoma	8,800	0	7,700
		Millerton Lake	427,800	110,800	198,500
		Shasta	3,998,000	2,168,200	3,322,900
		Vermillion	125,100	51,700	(1)
	Klamath	Clear Lake	172,300	5,300	365,200
		Gerber	94,300	10,700	52,500
		Upper Klamath Lake	524,800	228,900	380,300
	Orland	East Park	47,900	4,200	22,400
		Stony Gorge	50,000	13,300	22,600
Region 3	Boulder Canyon	Lake Mead	27,207,000	12,490,000	13,266,000
	Davis Dam	Lake Mohave	1,809,800	1,351,000	1,314,000
	Parker Dam Power	Havasu Lake	688,000	618,000	651,000
	Salt River	Bartlett	179,500	11,000	6,000
		Horse Mesa	245,100	230,000	204,000
		Horseshoe	142,800	65,000	4,000
		Mormon Flat	57,900	57,000	53,000
		Roosevelt	1,381,600	306,000	7,000
		Stewart Mountain	69,800	57,000	33,000
Region 4	Eden	Big Sandy	35,000	7,600	11,000
	Fruitgrowers	Fruitgrowers	4,500	700	500
	Humboldt	Rye Patch	179,000	200	43,400
	Hyrum	Hyrum	15,300	4,900	5,300
	Mancos	Jackson Gulch	9,800	4,200	1,800
	Moon Lake	Midview	5,800	3,500	3,600
		Moon Lake	35,800	4,300	4,700
	Newlands	Lahontan	290,900	79,000	208,200
		Lake Tahoe	732,000	360,000	676,800
	Newton	Newton	5,300	400	100
	Ogden River	Pineview	44,200	15,700	13,500
	Pine River	Vallecito	126,300	78,000	46,100
	Provo River	Deer Creek	149,700	86,100	103,600
	Scofield	Scofield	65,800	10,100	8,500
	Strawberry Valley	Strawberry Valley	270,000	147,200	137,600
	Truckee Storage	Boca	40,900	27,600	21,100
	Uncompahgre	Taylor Park	106,200	74,500	62,500
	Weber River	Echo	73,900	13,400	16,700
Region 5	W. C. Austin	Altus	166,300	29,800	22,700
	Balmorhea	Lower Parks	6,500	2,400	300
	Carlsbad	Alamogordo	131,900	97,700	2,200
		Avalon	6,000	2,100	1,300
		McMillan	38,700	10,700	16,000
	Colorado River	Marshall Ford	1,835,300	800,500	550,800
	Rio Grande	Caballo	340,900	21,300	5,700
		Elephant Butte	2,185,400	121,500	39,000
	San Luis Valley	Platoro	60,000	1,200	3,500
	Tucumcari	Conchas [2]	465,100	177,700	87,400
Region 6	Missouri River Basin	Angostura	92,000	85,700	37,000
		Boysen	710,000	248,800	525,300
		Canyon Ferry	1,615,000	1,517,100	1,417,600
		Dickinson	13,500	4,000	3,700
		Fort Randall [2]	3,900,000	1,343,100	1,506,800
		Heart Butte	218,700	65,500	57,600
		Keyhole	270,000	24,300	12,100
		Shadehill	300,000	77,400	80,700
	Belle Fourche	Belle Fourche	185,200	45,100	15,400
	Fort Peck	Fort Peck [2]	14,877,000	3,042,900	1,856,300
	Milk River	Fresno	127,200	105,300	82,000
		Nelson	68,800	41,400	39,900
		Sherburne Lakes	66,100	34,800	40,200
	Rapid Valley	Deerfield	15,100	9,500	8,300
	Riverton	Bull Lake	155,000	110,000	124,400
		Pilot Butte	31,600	10,000	12,000
	Shoshone	Buffalo Bill	380,300	213,700	326,500
	Sun River	Gibson	105,000	60,400	46,000
		Pishkun	30,100	22,500	17,300
		Willow Creek	32,400	25,700	23,800
Region 7	Colorado-Big Thompson	Carter Lake	109,100	21,200	19,100
		Granby	465,600	158,200	192,400
		Green Mountain	146,900	140,700	134,300
		Horsetooth	141,800	28,800	39,200
		Shadow Mountain	1,800	1,400	1,100
	Missouri River Basin	Bonny	39,900	34,900	37,400
		Cedar Bluff	176,800	81,900	77,600
		Enders	36,000	27,600	29,500
		Harry Strunk Lake	33,900	11,800	18,400
		Swanson Lake	116,100	43,300	65,300
	Kendrick	Alcova	30,300	22,600	20,600
		Seminoe	993,200	408,300	374,800
	Mirage Flats	Box Butte	30,400	6,400	5,300
	North Platte	Guernsey	44,200	18,000	21,800
		Lake Alice	11,400	800	3,800
		Lake Minatare	57,800	7,900	6,500
		Pathfinder	1,010,900	215,600	33,600

[1] Not reported.
[2] Corps of Engineers Reservoir.

LETTERS

Protective Coatings for Steel Water Pipes?

August 24, 1956

DEAR SIRS: We have read with much interest Mr. Paul Lewis' article on Protective Coatings for Steel Water Pipes in the August 1956 issue.

The information on the performance of different paints or coatings after several years of service on the inside, or outside, of power penstocks is indeed valuable.

We realize that these particular tests did not consider the effect on the value of "n," but would imagine that the Bureau has investigated increase in friction loss with age; and differences in "n" in new pipes, with various types of lining.

Can you give me any information on these points? Any data yau may have, or can refer to, would be appreciated.

Very truly yours,

(Sgd.) LESHER S. WING,
Regional Engineer,
Federal Power Commission,
555 Battery Street,
San Francisco 11, Calif.

Dear Sir: We are asking our Denver Office to look into this matter and report to you direct.—Ed.

September 4, 1956

DEAR SIRS: We were very much interested in an article on Protective Coatings for Steel Water Pipes in the August issue of the *Reclamation Era.* The author is Paul W. Lewis.

We would appreciate your advising the proper address of Mr. Lewis who is head of the Paint Laboratory Section, Engineering Laboratories, Denver, Colorado.

Thank you.

Yours very truly,

(Sgd.) LAMONT ROWLANDS,
Lamont Rowlands, Secretary,
Tung Growers Council of America,
Picayune, Mississippi.

Mr. Lewis may be reached at the Bureau of Reclamation, Building 53, Denver Federal Center, Denver, Colorado. His title is Supervising Materials Engineer.—Ed.

Thank You, Mr. Welsh!

August 9, 1956

DEAR SIRS: I have just received the last issue of "Reclamation Era." I think you are doing an exceptionally fine job and I always enjoy reading your articles very much.

I appreciate too, the fact that, you reproduced the article about the "Early Rising Farmer" and that you gave us credit, although we really did not deserve it. I found out just recently, that the letter was originally written by Ross Morris, one of our old-time NRA members from Zillah, Washington.

Sincerely,

(Sgd.) Wm. E. Welsh
WILLIAM E. WELSH,
Secretary-Manager,
National Reclamation Association,
897 National Press Bldg.,
Washington 4, D. C.

DO YOU KNOW:

That as presently planned, construction of the newly authorized Colorado River Storage Project and 11 participating projects will include 6,785,000 cubic yards of concrete and 60,266,000 cubic yards of earth dam construction for reservoirs having a total storage capacity of 33,312,000 acre-feet. Also included will be construction of powerplants having a total capacity of 1,033,000 kilowatts, 40 miles of tunnels, 790 miles of canals and laterals, and 80 miles of pipelines.

For comparison, the concrete dams to be built will have about the same total volume as Hoover, Friant and Monticello Dams. The earth dams total about the same as Anderson Ranch, Palisades, Cedar Bluff, Kirwin, Bonny, Webster, and Tiber Dams. Shasta, Hungry Horse, Davis, Parker, and Elephant Butte Powerplants together have about the same generating capacity (1,033,300 kilowatts) as the Storage project.

Largest of the storage dams is Glen Canyon, which will be a concrete arch structure 700 feet high above foundation containing 5,060,000 cubic yards of concrete, and having a 900,000-kilowatt powerplant. It will be the second highest dam in the United States, exceeded in height only by Hoover Dam. Glen Canyon's 26,000,000 acre-foot reservoir will reach 186 miles up the Colorado River from the dam site just south of the Utah-Arizona bounary, and will be outranked in capacity only by Lake Mead.

That in 1954, Federal Reclamation projects produced 26.6 million tons of farm crops. If this were all moved by rail, it would require 760,000 thirty-five-ton railway cars. End to end this would represent a train 6,477 miles in length—more than twice the distance from the Atlantic to the Pacific coast. This production valued at the farm was worth $865 million. When it reached its final use as processed food or manufactured clothing, it was far from home and its value was many times that received by the farmer.

That the number of visitors to the 140 Bureau of Reclamation reservoirs serving recreational uses has increased from 6.5 million to 9.6 million in the past 4 years. Possibly 10 million people will enjoy these facilities during the current 1956 summer season.

That the Third Congress of the International Commission on Irrigation and Drainage will be held in San Francisco in May 1957. The United States National Committee of the Commission will be host to the 34 member countries of the Commission. Walter E. Blomgren, former Bureau of Reclamation Assistant Chief Engineer, is Chairman of the U. S. National Committee. In addition to a technical program, the Congress will include study tours of Reclamation projects in California. Secretary of the Interior Fred A. Seaton and Reclamation Commissioner W. A. Dexheimer, and some 70 other distinguished representatives of government, education, industry, and the engineering profession will serve as members of the Honorary Committee for the Congress.

That Washington State Highway Department budgets about two percent of its new highway costs for landscaping and grass seeding. This seems like a small sum until you realize the high costs of highways and how far a little grass seeding will go.

THE PAY-OFF

A forward-looking irrigation district decided to get grasses established on all its canals, laterals, and drains. Each year a part of the system was planted to grasses. They sprayed with 2, 4D to keep the weeds out of the new plantings. Then the farmers decided to help. Where ditches crossed their property, they planted grasses. The ditch company then permitted controlled grazing of the ditchbanks. The pay-off—for every dollar invested in planting grasses, $2.50 in maintenance cost was saved and the increased pasture help the cattle put on gains at less cost.

New Recreational Folder Available

A new recreational folder, entitled "Reclamation's Recreational Opportunities," has just been published by the Bureau.

The folder lists 140 reservoirs on Reclamation projects throughout the 17 Western States. It also contains information as to specific locations of these reservoirs, the name and location of the administering agency and specific facilities available; such as swimming, fishing, boating, hunting, camping, picnicking, and lodging. The folder also contains a map on which the name and location of each reservoir is indexed.

For copies write to your nearest Regional Director or the Assistant Commissioner and Chief Engineer's office at Denver. For addresses of these offices please consult the directory on the back cover of the *Era.*

MAJOR RECENT CONTRACT AWARDS

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DC-4620	Columbia Basin, Wash	Sept. 11	Construction of Wahluke siphon, station 0+00 to 159+05.13; Wahluke Branch canal; and PE16.4 wasteway, station 577+40 to 677+25, utilizing monolithic-concrete pipe in the siphon, schedule 1.	E-W Construction Co., Eugene, Oreg.	$6, 204, 770
DC-4691	Yakima, Wash	July 18	Construction of earthwork, pipelines, and structures for Main canal laterals, station 1325+00 to 2206+06.6; and Amon pump discharge line and laterals.	Cherf Brothers, Inc., and Sandkay Contractors, Inc., Ephrata, Wash.	387, 263
DC-4694	Missouri River Basin, N. Dak.	Aug. 23	Construction of Grand Forks substation	Electrical Builders Associated, Mayville, N. Dak.	147, 338
DC-4698	Columbia Basin, Wash	Sept. 10	Construction of Frenchman Springs pumping plant, discharge lines, and approach lateral W53.1, Block 79.	Commercial Builders, Inc., Moscow, Idaho.	618, 030
DC-4700	Central Valley, Calif	July 10	Construction of earthwork, concrete pipelines, and structures for laterals 5.3, 14.0, 36.6, and Y-2.6, Contra Costa canal distribution system, Contra Costa County Water District.	McGuire & Hester, Oakland, Calif.	301, 086
DC-4701	Ventura River, Calif	July 5	Construction of Casitas Dam	Winston Bros. Co., Monrovia, Calif.	8, 576, 388
DC-4702	Rogue River Basin, Oreg.	Aug. 31	Construction of Deadwood tunnel with tunnel having a 6-foot diameter horseshoe section, schedule 2.	Lord Bros. Contractors, Portland, Oreg.	426, 302
DC-4706	Missouri River Basin, Wyo.	July 20	Construction of earthwork, structures, and surfacing for relocation and north grade raise of Wyoming State highway, U. S. No. 87, Glendo dam and reservoir.	Platte Valley Construction Co., Grand Island, Nebr.	692, 660
DS-4708	Missouri River Basin, Wyo.-Nebr.-Colo.	Aug. 20	1 main control board, switchboard carrier-current relaying equipment, graphic board equipment, 10 carrier current transmitter-receiver sets, carrier ground relay, and line protective and carrier-current control and auxiliary relays and accessories for Casper, Gering, and Lingle substations, Flatiron dispatching station, and Glendo and Guernsey powerplants, schedule 2.	General Electric Co., Denver, Colo.	104, 551
DC-4716	Solano, Calif	Aug. 24	Construction of Putah diversion dam and Putah South canal, station 12+46.44 to 14+10.	George Pollock Co., Sacramento, Calif.	799, 893
DC-4719	Columbia Basin, Wash	Aug. 21	Construction of Burbank pumping plants Nos. 2 and 3, approach channels BP-2 and BP-3, and discharge lines, block 3.	Lewis Hopkins Co., Pasco, Wash.	309, 976
DC-4721	Michaud Flats, Idaho	Aug. 27	Construction of earthwork and structures for Main canal—West.	North Side Construction Co., Jerome, Idaho.	134, 733
DC-4722	Central Valley, Calif	Sept. 12	Trinity Government community facilities	Barry J. Richards Co., Studio City, Calif.	1, 576, 589
DC-4729	Boise, Idaho	Sept. 24	Construction of "C" Line canal pumping plant extension	Quinn Bros. & Robbins, Inc., Boise, Idaho.	114, 490
DC-4730	Colorado River Storage, Utah-Ariz.	Sept. 21	Construction of earthwork and culverts for access highway for Glen Canyon Dam, station 158+67.7 to 400+00.	Strong Co., Springville, Utah	1, 156, 244
DC-4732	Central Valley, Calif	Sept. 13	Construction of earthwork, pipelines, and structures for Shafter-Wasco laterals and sublaterals: completion of laterals 134.4 and 137.2; and sublaterals for lateral 134.4 feeder main, Shafter-Wasco irrigation district, Friant-Kern canal distribution system.	Cen-Vi-Ro Pipe Corp., South Gate, Calif.	5, 638, 539
DC-4736	Columbia Basin, Wash	Sept. 28	Construction of earthwork, concrete lining, and structures for Burbank canal laterals, block 3.	Lewis Hopkins Co., Inc., Pasco, Wash.	302, 708
DC-4737	Central Valley, Calif	Sept. 19	Construction of county road relocation for Trinity Dam; access road for Lewiston Spring Creek tunnel; and piers, abutments, and approach for Trinity River bridge.	Transocean Engineering Corp., Hayward, Calif.	869, 631
DC-4744	do	Sept. 18	Construction of earthwork and footing modification for Sacramento River crossing tower 2-C, 230-kv. Shasta-Tracy transmission lines 1 and 2 (West side lines).	Darkenwald Construction Co., Inc., Sacramento, Calif.	173, 490
400C-63	Colorado River Storage, Ariz.-Utah.	Aug. 14	Exploratory drilling and water testing at Glen Canyon dam site.	Cannon Diamond Drilling Co., Ltd., Compton, Calif.	148, 185
400-426	Central Valley, and Colorado River Storage, Colo.-Ariz.-Calif.-Utah.	Aug. 1	Portable houses for Lewiston, Calif., and Glen Canyon, Flaming Gorge, and Navajo units.	Transa Homes Corp., Fullerton, Calif.	563, 547

U. S. GOVERNMENT PRINTING OFFICE: 1955 O—399027

Construction and Material for Which Bids Will Be Requested Through December 1956[1]

Project	Description of work or material
Central Valley, Calif.	Constructing the 465-foot-high earth and rockfill Trinity Dam, containing about 30 million cubic yards of material, with crest length of 2,430 feet, and appurtenant structures. On Trinity River, about 45 miles northwest of Redding.
Do	Constructing the 17-foot 6-inch concrete-lined Clear Creek Tunnel, about 11 miles long. Work will include a reinforced concrete surge tank and intake tower structure. 15 miles northwest of Redding.
Do	Improving about 9 miles of county road from Trinity River crossing to Trinity Dam site. Near Lewiston.
Chief Joseph Dam, Wash.	Constructing the 3 Brewster Flat pumping plants. Work will include 1 outdoor pier-type plant with a single-span approach bridge and with fish protection facilities. This plant is to be located on the Columbia River and is to pump 50 cfs to the second plant, a booster plant, which is to be an indoor-type plant with a reinforced concrete floor slab and a structural steel superstructure with metal roofing and siding and a traveling crane. The third plant, a relift plant of 39-cfs capacity, is to be an outdoor-type plant with a reinforced concrete floor slab. Work will include steel pipe discharge lines, steel tank reservoirs, switchyards and transmission lines. Also to be included will be the installation of 11 Government-furnished pump units and electrical equipment. Near Brewster.
Colorado-Big Thompson, Colo.	One 4,500-kva, 1.0 power factor, 4,160-volt, 400-rpm, vertical-shaft, hydraulic-driven, synchronous generator for the Big Thompson powerplant.
Colorado River Storage, Utah.	Grading 6.25 miles of road, constructing 1 mile of roadway embankment, constructing 0.25 mile of new road, and constructing a 435-foot-long temporary pile bent timber bridge over the Green River. Flaming Gorge access road, about 40 airline miles north of Vernal.
Do	Furnishing and erecting a highway bridge over the Colorado River including a 1,028-foot, single-span steel arch of carbon steel and high alloy steel members, rise of arch 165 feet, and including a reinforced concrete deck for 30-foot roadway width and two 4-foot walkways. Top of roadway 700 feet above river level. Glen Canyon Unit about 165 miles north of Flagstaff.
Columbia Basin, Wash.	Earthwork and structures for about 50 miles of unlined open laterals, wasteways and drains with bottom widths varying from 12 to 2 feet. Block 85, north of Smyrna.
Do	Deepening drains and constructing about 29 miles of deep and semideep drains, road crossings, and drain inlets. Block 43, near Warden.
Deschutes, Oreg	Excavating, grading, and gravel surfacing about 10 miles of secondary county road at the Haystack Reservoir. Near Culver.
Gila, Ariz	1 synchronous, motor-driven, vertical-shaft, centrifugal-type pumping unit with capacity of 275 cfs at a total head of 54 feet for the Yuma-Mesa pumping plant.
Michaud Flats, Idaho.	Constructing 7.5 miles of welded steel pipe laterals for sprinkler-type irrigation. Near American Falls.
MRBP, Iowa	One 230,000-volt, 5,000-mva interrupting capacity power circuit breaker for Sioux City substation.
MRBP, Kansas	Earthwork and structures for Courtland Canal and laterals, including 21.2 miles of unlined open canal and laterals with bottom widths varying from 20 to 3 feet for Miller Canal and laterals, including 22.4 miles of open canal laterals with bottom widths varying from 16 to 3 feet. North of Courtland.
Do	Earthwork and structures for about 16.3 miles of Kirwin South Canal with bottom widths varying from 10 to 3 feet and about 10.3 miles of open laterals and sublaterals. Between Cedar and Portis.
MRBP, Montana	Constructing the 7-foot-diameter horseshoe Helena Valley Tunnel, about 2.6 miles long. 15 miles east of Helena, adjacent to Canyon Ferry.
Do	Constructing the outdoor-type Helena Valley pumping plant of reinforced concrete with a structural steel crane runway and overhead traveling crane and an approach bridge.
Do	Three 5,000-kva, 110–69–34.5-kv mobile autotransformers complete with trailers for use in Region 6.
MRBP, Nebraska	Earthwork and structuresf or additions and extensions to Cambridge and Bartley Canal and lateral systems. Near Cambridge and Arapahoe.
MRBP, North Dakota and Minnesota.	Clearing right-of-way, furnishing and installing fence gates, constructing footings, and furnishing and erecting steel towers for about 160 miles of single-circuit, 230-kv transmission line from Fargo, N. Dak., to Granite Falls, Minn.
MRBP, South Dakota.	Clearing right-of-way, furnishing and installing fence gates, constructing footings, and furnishing and erecting steel towers for about 65 miles of single-circuit, 230-kv transmission line from Utica Junction to Sioux Falls.
Do	Constructing a 50- by 105-foot power system dispatching building which is to have a steel frame with exterior masonry walls and basement walls of concrete. At Watertown.
MRBP, Wyoming.	Constructing the indoor-type Fremont Canyon Power Plant and a lined pressure tunnel. The powerplant is to include reinforced-concrete superstructure walls enclosing a structural steel frame for two 33,500-hp turbines and two 25,263-kva generators, installation of 2 butterfly valves about 12 feet in diameter, one 100-ton crane and 2 draft-tube bulkhead gates, furnishing and installing two 10-foot 9-inch diameter steel penstocks 400 feet long.
Rogue River Basin, Oreg.	Constructing the 86-foot-high, 990-foot-long earth and rockfill Howard Prairie Dam. Work will include a spillway with approach channel, concrete crest structure, chute, and stilling basin; and an outlet works with concrete intake structure, fish screen structure, conduit, gate chamber, control house, and stilling basin. On Beaver Creek, about 27 miles east of Ashland.
Do	Constructing about 10.3 miles of open canal including 2.3 miles of 6- by 3.75-foot rectangular reinforced-concrete flume section, 7.5 miles of 2.2-foot bottom width unreinforced-concrete-lined canal, and 0.5-mile of 48-inch precast concrete pipe siphon; a small rockfill-type diversion dam with sluiceway and canal headworks and about 1.65 miles of 2-foot bottom width unreinforced concrete-lined canal. Howard Prairie Canal and Soda Creek Dam. 15 miles east of Ashland.
Do	One 16,842-kva, 0.95 power factor, 4,160-volt, 600-rpm, vertical-shaft, hydraulic-driven, synchronous generator for Green Springs Power Plant.
Shoshone, Wyo	Replacing the upstream portion of the lower outlet works with a new intake shaft and tunnel equipped with bulkhead gate and hoist and trashrack structure. Plugging the existing intake tunnel under water. Rehabilitating the existing slide gates and replacing one existing 58-inch balanced valve with an 84-inch needle valve. Replacing trashracks on the penstock intakes with new metal intake wells with cylindrical trashracks. At Buffalo Bill Dam, 6 miles west of Cody.
Do	Constructing 3.5 miles of closed drains, 1.1 miles of open drains, and converting about 1.6 miles of open drains to closed drains. Near Powell.
Solano, Calif	One 14-inch hollow jet valve (estimated weight: 900 pounds), and 1 lot of 14-inch piping, gate valves, and fittings (estimated weight: 4,000 pounds) for Monticello Dam.
Ventura River, Calif.	One 48-inch hollow jet valve for Casitas Dam. Estimated weight: 23,000 pounds.
Weber Basin, Utah.	Furnishing and laying about 21,000 feet of 24-, 27-, and 30-inch precast concrete pressure pipe, part of which will be steel cylinder-type pipe with pretensioned reinforcement, and constructing 1 concrete-lined equalizing reservoir, for Davis Aqueduct trunklines. About 10 miles north of Salt Lake City.
Do	Constructing the P2.8R pumping plant and about 14 miles of the Uintah Bench pipe laterals consisting of about 11 miles of 12- to 36-inch precast reinforced-concrete pipe, about 1.5 miles of 12- to 24-inch precast concrete steel cylinder-type pipe and about 1.5 miles of 8- and 10-inch steel or asbestos cement pipe. South of Ogden.
Yakima, Wash	Constructing about 12 miles of surface drains. Near Kennewick.

[1] Subject to change.

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The Reclamation Era

February 1957

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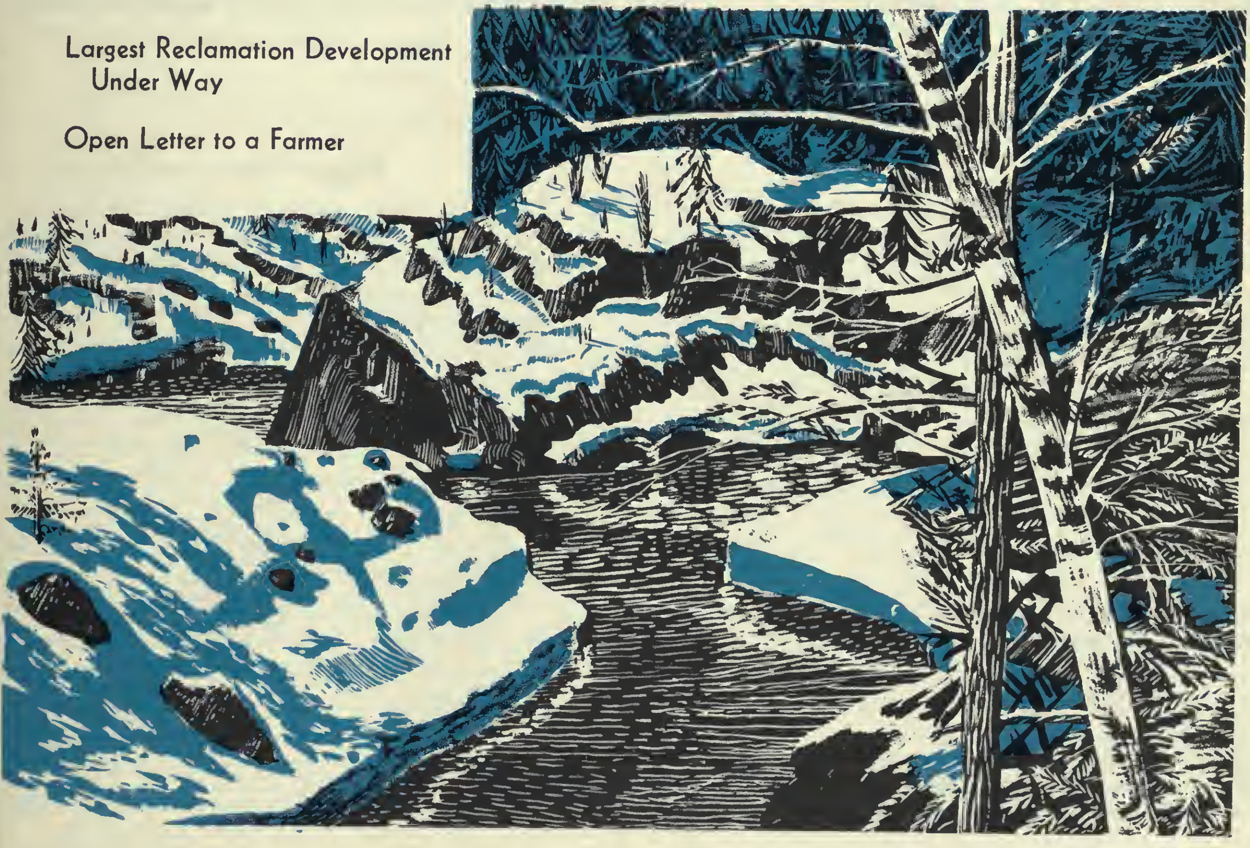

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In this issue . . .

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* * *

Thirty Years Ago In The Era

Crop rotation is a farm practice which may be used by the farmer to increase the productivity of the soils as effectively as by the use of manure or commercial fertilizers.

DESIGN AND ILLUSTRATIONS by Drafting and Graphics Branch
Bureau of Reclamation, Washington, D. C.

J. J. McCARTHY, Editor

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LARGEST RECLAMATION DEVELOPMENT UNDER WAY

PRESIDENT DWIGHT D. EISENHOWER in the Cabinet Room at the White House presses golden key starting construction on the Colorado River Storage Project. With the President is Secretary of the Interior Fred A. Seaton. Above: GROUND-BREAKING at Glen Canyon Dam site. Presidential photo by Abbie Rowe, National Capital Parks.

The Story of the Colorado River Storage Project

by C. B. JACOBSON
Chief, Upper Colorado River Office

PRESIDENT EISENHOWER officially initiated construction on the Colorado River Storage Project and Participating Projects on October 15, 1956, by pressing a golden telegraph key at his White House office to give the signal for explosions at the Glen Canyon and Flaming Gorge dam sites. A construction contract had been awarded on October 1 for drilling the right diversion tunnel at the Glen Canyon dam site, and the explosion signaled by Ike ripped loose rock from the canyon wall at and above the outlet portal as the first step in the tunnel construction. At the Flaming Gorge dam site, the explosion stripped rock from high on the left abutment.

Prominent officials from the States and communities of the Upper Colorado River Basin and representatives of the Bureau of Reclamation were present at both dam sites to receive the President's signal and to view the historic explosions.

Thus, October 15, 1956, is the construction birthday of the Upper Colorado River development program which had been authorized by the Congress and signed into law by President Eisenhower on April 11, 1956, as Public Law 485, 84th Congress.

The Colorado River Storage Project and Participating Projects, as the authorized basinwide development is called, is the largest single authorization in the history of Reclamation. This authorization provides for the initial phases of the ultimate development plan for the Upper Colorado River Basin.

High on Canyon rim of Glen Canyon Dam site Senator Arthur V. Watkins (center) of Utah, speaks to President Eisenhower via a special telephone-public address system hookup at the ceremony. L. to R.: L. F. Wylie, Project Construction Engineer, Glen Canyon Dam; Senator Watkins; E. O. Larson, Regional Director, Region 4.

Four units for storage and power are authorized under the Colorado River Storage Project. They are the Glen Canyon Unit, on the main stem of the Colorado River in northern Arizona at a point about 15 miles upstream from Lee Ferry on the boundary between the upper and lower Colorado River basins; Flaming Gorge Unit on the Green River in northeastern Utah; the Curecanti Unit of 3 or 4 dams and powerplants on the Gunnison River in Western Colorado; and the Navajo Unit on the San Juan River in Northern New Mexico. The construction of 11 irrigation and multiple-purpose projects participating in the upper basin plan is also authorized. Five of these participating projects (Silt, Paonia, Smith Fork, Florida, and Pine River Extension) are in Colorado; three are in Wyoming (LaBarge, Seedskadee, and Lyman); two are in Utah (Central Utah and Emery County); and one (Hammond Project) is in New Mexico. The Eden Project now nearing completion in Wyoming will also be assisted by the power revenues from the Colorado River Storage Project.

The initially authorized group of storage units and participating projects will result in construction of 17 dams which will provide nearly 36 million acre-feet of reservoir capacity; over 1,200,000 kilowatts of hydroelectric installed capacity; 48,-800 acre-feet annually of water for municipal and industrial uses; a full water supply for 132,000 acres of new land; and a supplemental water supply for 240,000 acres of land now suffering from shortage of irrigation water.

The combined water surfaces of the reservoirs will approximate 400 square miles. Tremendous opportunities for recreational activities will be offered, such as swimming, boating, fishing, picnicking, camping, and enjoyment of scenic areas heretofore inaccessible to the general public.

The 17 dams, if placed one on top of the other, would rise to a height of ¾ mile; end-to-end, they would extend more than 6 miles. About 60 million cubic yards of earth materials and about 6 million yards of concrete will go into these dams.

The haulage of cement and pozzolanas for the 5,000,000 cubic yards of concrete to be placed in Glen Canyon Dam alone would require the delivery of 20-ton truck loads at 45-minute intervals around the clock for 4 years.

Construction of the 4 authorized storage units and 11 participating projects will require an estimated 185,000 man-years of labor. This labor requirement would be split into two parts—⅓ at the site of construction and ⅔ in the off-site production of necessary materials and in meeting transportation and administrative needs. The basic materials, such as iron, steel, copper, aluminum, cement, and lumber, must come from far-flung sources. From their beginning as raw materials to final finished products delivered to the project sites, thousands of man-years of labor are required in mines, forests, transportation, processing, fabrication, distribution, and administration. Thus, every state in the Nation will be beneficially affected.

Glen Canyon Dam is the largest of the storage

GROUND-BREAKING explosion at Flaming Gorge Dam site. View is looking downstream to the dam site. Photo by F. H. Anderson, Region 4.

units. It will rise 700 feet above bedrock and create a reservoir of 28 million acre-feet extending 186 miles up the Colorado River. The crest length of the dam will be 1,400 feet, and the volume of concrete will total about 5 million cubic yards. The 8 generating units to be installed in the powerhouse will have a total capacity of 900,000 kilowatts. The total construction cost, including an apportioned share of the authorized transmission system, is estimated to be $421 million.

The right diversion tunnel at the Glen Canyon dam site is now being excavated. Access roads to the dam site are now under construction. An alternate route for U. S. Highway 89 will cross Glen Canyon on the highest steel arch bridge in the United States at a point 870 feet downstream from Glen Canyon Dam. Bids for construction of this bridge were opened on December 18. About 2 years will be required to complete construction of this magnificent steel bridge.

The prime contract for Glen Canyon Dam will be awarded in the spring of 1957, according to present schedules. The prime contract will include construction of the dam, the powerhouse, the left diversion tunnel, the lining of both diversion tunnels, and the two cofferdams needed to divert the Colorado River during construction of the dam.

Diamond core drill operating near axis of Flaming Gorge Dam site. Photo by F. H. Anderson, Region 4.

L. to R.: Interior Secretary Fred A. Seaton; President Dwight D. Eisenhower; Reclamation Commissioner W. A. Dexheimer in the Cabinet Room at the White House. Photo by Abbie Rowe, National Capital Parks.

Flaming Gorge Dam will rise about 500 feet above bedrock and have a crest length of 1,200 feet. About 1 million cubic yards of concrete will be placed in constructing this high dam. The reservoir behind Flaming Gorge Dam will extend 94 miles upstream, nearly to the town of Green River, Wyo. About 4,000,000 acre-feet of water will be impounded. The estimated cost is $57 million.

A temporary access road is now being built from Linwood, Utah, to the Flaming Gorge dam site. Drilling of the single diversion tunnel at the Flaming Gorge dam site will be under contract by early summer. Present plans call for issuance of the invitation for bids on the prime contract in October 1957.

As specified in the authorizing legislation, construction of the Curecanti Storage Unit must be delayed pending completion of a feasibility report. Economic consideration of the Curecanti Unit involves comparative designs and estimates of several combinations of dams, powerplants, and reservoirs on the reach of the Gunnison River near Gunnison, Colo.

Field investigations are underway at the Navajo dam site. Construction of access roads and other facilities are planned for spring of 1957. Navajo Dam will be used primarily in connection with New Mexico's contemplated new uses of San Juan

(Continued on p. 22)

UNDERWATER TELEVISION TEST AT SHASTA DAM

by A. W. SIMONDS
Engineer, Commissioner's Office
Denver, Colo.

With the present development of industrial television for underwater use, a great field of view which has formerly been seen by relatively few people, has now become visible to many. Formerly, this field, which lies beneath the surface of water ranging from a few feet to many feet in depth, could be seen only by divers, but now by means of the television camera, it can be seen by many observers above the surface.

Sunken hulks of ships, wrecks of crashed airplanes, and the under sides of modern ships are only a few of the objects which have been brought to view by means of TV. Its use is of particular interest to the Bureau of Reclamation as a means of examining the underwater conditions of hydraulic structures. In this field the underwater use of TV offers many potential opportunities.

Formerly, the examination of underwater conditions of hydraulic structures required the services of one or more divers with their accessory equipment. This arrangement has not been satisfactory at times because the conditions observed and described by the divers and communicated to the surface by telephone to parties concerned, are affected by the personal reactions of the diver. This personal factor enters into the verbal description transmitted, and may considerably alter the impressions on the minds of the parties at the surface. With a portable television camera adapted for underwater use, the surface parties can see the actual conditions which exist under water. This viewing, supplemented by a diver's commentary, enables the observers on the surface to obtain exact knowledge of existing conditions.

At present there are a number of commercial diving operators who are making use of TV equipment for underwater surveys. Inasmuch as this is a relatively new procedure, considerable interest has been shown in this method by organizations having essential underwater installations. In August 1955, a west coast diving firm offered to demonstrate its underwater TV equipment at Shasta Dam, a major structure on the Central Valley Project in California. The Bureau of Reclamation cooperated by making available barges, compressed air, electricity and other necessary items.

PREPARING THE DIVER FOR DESCENT.

The place selected for the demonstration was in the spillway bucket near the Shasta Powerplant. In this area several of the spillway apron

steps were known to be damaged by erosion and cavitation, and the diving firm offered to examine some of the damaged areas with its equipment for the demonstration. By mutual agreement, arrangements were made for the demonstration.

The divers used two barges; one 18 by 40 feet for observers and a smaller one about 8 by 12 feet for an operating base. A small rowboat was available for emergency use. Compressed air was supplied from the Shasta Powerplant to the barge through a 2–inch diameter hose which was connected to a receiver sufficiently large to hold a reserve supply of air for one diver for about a 10-minute period. The individual equipment for the diver consisted of a watertight suit complete with boots, helmet, and telephone.

The TV equipment consisted of a television camera, a control unit, and two monitors. The television camera was a small unit mounted in a watertight cylindrical case about 10 inches in diameter by 30 inches long, having a suitable handle for carrying. A 1,000-watt underwater lamp was mounted on the forward end of the case for illuminating the area to be viewed. The camera was connected to the control unit by means of a multiconductor cable. When in use, the camera was carried under water by the diver who aimed it at the object desired for scanning.

Two monitors were provided for the group of about 25 observers. Both of these were mounted on a table on the larger barge. A tent had been erected on the barge to provide a darkened area for viewing the images shown on the monitors.

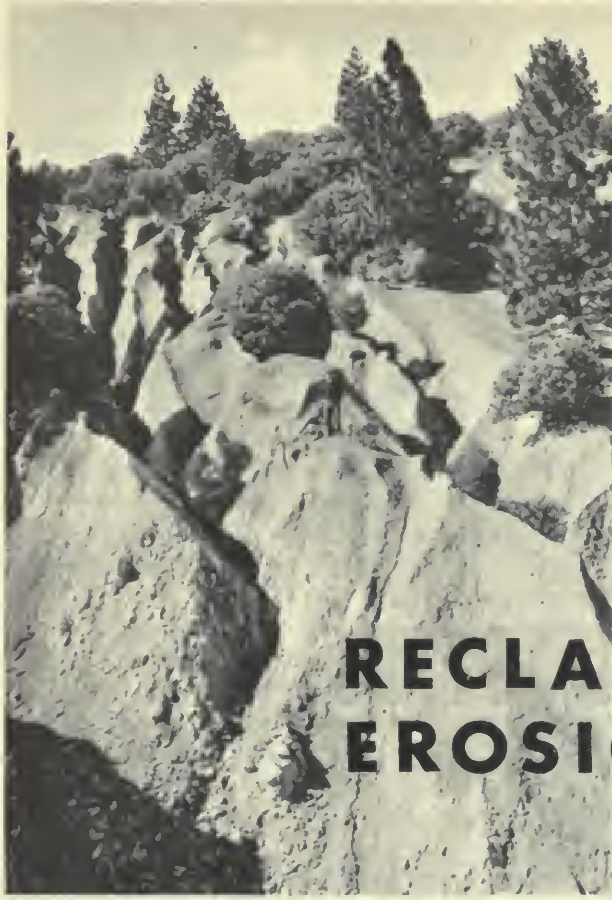
The diver with the TV camera made a descent into the spillway basin where the water was about 38 feet deep. He walked transversely on the spillway apron downstream from the spillway apron steps. The images of these steps appeared on both monitors on the barge and showed that the concrete at the downstream faces and sides of some of the steps had been eroded severely in a few places. The concrete had been worn away to a depth of several inches at several piers, sufficiently to expose the reinforcement steel. The diver carried a carpenter's folding rule, painted white, which was used to point out the defects. The images of the rule appearing on the monitors were not clear enough to read the inch markings, but the depth of the erosion could be estimated by the 6 inch sections of the rule which were readily discernible.

TV CAMERA and light in watertight case—above. At right: CONTROL UNIT and monitors for underwater TV.

The images shown on the monitors were clear enough in most cases for the observers to see the exposed aggregate of the concrete. It was only when the diver walked through an accumulation of muck or silt in the plant growth on the bottom of the apron and stirred it up that the images became too cloudy to show anything.

This demonstration proved conclusively that TV is a useful and practical means of making underwater surveys of the submerged parts of hydraulic structures. ###

RECLAMATION AND EROSION CONTROL



EROSION SCARS typical of "smelter flume" area near Shasta Reservoir. ***J. D. Leeper Photo.***

by L. G. TEMPLE
Soil Conservationist
Region 2, Sacramento, Calif.

The disintegration of rock into soil by the action of wind, water, freezing and thawing, is a natural phenomenon which never stops. Many aeons passed before man appeared upon the scene and then only in places where through erosion, enough soil had been formed to support plant life.

For thousands of years man led a nomadic life, due to his top soil becoming impoverished, blown away by high winds, or washed away by floods. As the earth's population increased, so the demand for soil to grow food increased, and man began to realize that the answer was not in flight, but in conservation and fertilization.

Until relatively recent times conservation of our natural resources was more or less a hit and miss proposition, with too little coordination, and little or no effort made to inform the general public of the seriousness of the problem.

When the question of soil conservation arises, inevitably the question is asked "How much will it cost?" When we consider the fact that some three billion tons of top soil are lost each year in these United States by excessive erosion, and that 600 to 1,000 years are required to form one inch of top soil, a more important question may well be "How much is our Nation's future worth?"

For many years the Bureau of Reclamation has been cognizant of the many soil erosion problems and that while much has been done, much more work remains to be done to reduce the loss of top soil to a minimum. These problems are of particular interest to the Bureau when they affect lands or facilities under its jurisdiction, as illustrated in the Keswick Dam area.

From about 1900 until 1925 three smelters were in operation along the Sacramento River in the canyon north of Redding, Calif. The acrid fumes from these smelters completely denuded the west watersheds of all vegetation, between the old towns of Keswick and Kennett. With an annual rainfall in excess of 60 inches, mostly between October and April, falling upon these barren and rugged slopes, the terrain was reduced to a maze of gullies, with the eroded soil, sand, gravel and even large rocks going into the Sacramento River.

Prior to the construction of Shasta Dam and Keswick Dam, the eroded material from the watersheds was carried through the canyon and down the valley, by the annual flooding of the river. After the dams were constructed, this material could no longer be sluiced out of the canyon, but remained in the reservoirs.

Since 1925, considerable natural recovery of plant material has taken place, principally Manzanita and several species of Ceanothus. A planting program of conifers by the C. C. C. camps

produced fair results. The U. S. Forest Service also established plantations of conifers in several places on the watersheds. These attempts to reforest the watersheds were valuable contributions, but were not the answer to a serious problem, as the gullies continued to grow deeper and wider, undercutting many of the conifers.

One of the principal interests of the Bureau of Reclamation was to find a practical solution to the erosion problem, in order to increase the potential lives of the reservoirs. Therefore a study of the watersheds was started in 1946. After some two years of investigation and experimental work, a three-phase plan of control was adopted, with all three phases being carried on concurrently according to the seasons.

Phase 1: Construct a series of check dams in all gullies, using brush and rocks available at the dam sites, trapping as much eroded soil as possible, and at the same time reducing erosion by breaking the velocity of the water flowing down the gullies.

Phase 2: Plant broadleaf seed, seedlings and cuttings of broadleaf plants at check dams and on denuded areas. Broadleafs established at check dams provide living barriers after the brush has decayed and on the denuded areas they will eventually provide protection against "raindrop erosion," also their roots and fallen leaves will provide further protection against surface erosion.

Phase 3: Reforestation of the entire watersheds with Ponderosa and Jeffrey pines. This is the long range phase, and while it is very important in the overall plan, it could not accomplish the desired results alone.

Considerable experimental work with various species of broadleaf plants indigenous to this region was carried out for the purpose of finding plant material which would produce the best results for the least amount of money and time expended.

Obviously the numerous types of grass used successfully against surface erosion on rolling land would be of little or no value on these rugged slopes, subjected to torrential winter rains and long, hot, dry summers.

Several species of plants which were known to be excellent for the purpose, had to be discarded due to propagation difficulties and excessive labor costs. Some species so discarded include Wild Blackberry, Wild Grape, Toyon, and several species of Ceanothus. Fortunately, natural distribution of these plants by birds and animals is very encouraging.

Those species which have proved advantageous and comparatively inexpensive to establish are Redbud, Willow, Acacia, Spanish Broom, Oleander and several species of Oak. All seed, acorns and cuttings are harvested locally by our own crews, thus only labor and transportation costs are involved.

Ponderosa and Jeffrey pine seedlings are purchased from the U. S. Forest Service under a cooperative agreement, at a nominal price.

Construction of a series of check dams in all gullies provides the mechanical means of holding eroded soil for immediate results, and the soil thus trapped provides the medium for plant growth. Each check dam breaks the velocity of the water flowing down the gullies and as long as the dams remain intact the gullies do not grow deeper.

The worst gullied condition is found in deep

Above: EROSION CONTROL. Overall view of 8-foot rock dam. Below: PONDEROSA PINES which made exceptionally good growth. ***Photos by J. D. Leeper and H. Colby.***

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clay with little or no rock available for dam construction, therefore most of the check dams are constructed with Manzanita brush. The species of manzanita used in check dam construction is a large shrub or small tree, with spreading stiff branches, and hard, oily wood, which decays slowly.

These brush dams are very effective if properly constructed, and failures have been small in number, probably less than 1 percent. The cutting of this brush for dam construction offers no serious erosion problems, as the ground under manzanita is literally covered with seed and it germinates readily when the overhead brush is removed.

During 1950 and 1951 we were quite concerned about the pine seedlings being severely trimmed by rodents and deer. We put into effect a poisoning campaign against rodents but there was little or no difference noted between heavily poisoned and unpoisoned areas. However, by late spring of 1952, there was ample proof that the severe trimming killed few, if any seedlings. Even a large percentage of seedlings cut off below the needles survived. We did notice that pine seedlings so damaged have heavier trunks, with spreading growth habits.

A survival check on 4 test plots of pine seedlings, over a period of 3 years showed the following results:

	Percent
North slope	94
East slope	76
South slope	35
West slope	60
Average survival	66.25

KESWICK WATERSHED view from cut bank above railroad looking southeast at wash into Keswick Lake. ***Photo by J. D. Leeper.***

Treatment of the Keswick Reservoir watersheds was given priority over the Shasta Reservoir watersheds, due to the much smaller capacity of the Keswick Reservoir. Treatment of the Keswick watersheds will be completed by the end of 1957 fiscal year.

The watersheds will be observed for several years for the effectiveness of treatment and its potential need for supplemental treatment.

As of May 18, 1956, the following work had been accomplished on the Keswick watersheds:

Check dams constructed (all types, sizes)	157,483
Pine seedlings planted	2,038,941
Oak (acorns) (all species; 120 to pound) pounds	59,571
Broadleaf seedlings planted	176,314
Broadleaf seed planted (pounds)	785
Willows, willow cuttings planted	302,459

Unfortunately we cannot lay claim to having found a panacea for all erosion problems, in fact, so many factors must be considered that each erosion control project requires treatment according to existing conditions. It is believed, however, that the "Three-Phase Plan" is the best answer to this particular problem. ###

New Recreational Folder Available

A new recreational folder, entitled "Reclamation's Recreational Opportunities," has been published by the Bureau.

The folder lists 140 reservoirs on Reclamation projects throughout the 17 Western States. It also contains information as to specific locations of these reservoirs· the name and location of the administering agency and specific facilities available, such as swimming, fishing, boating, hunting, camping, picnicking, and lodging. The folder also contains a map on which the name and location of each reservoir is indexed.

Copies may be purchased for 15 cents each or $9.50 per hundred from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

"EACH YEAR over 1,000,000 acres of cultivatable land is going into homesites, industrial and commercial developments, defense establishments, highways, airports, and other nonagricultural uses."—D. A. Williams, Administrator, Soil Conservation Service.

The how and the why of wildlife and windbreak plantings are told in this

OPEN LETTER to A FARMER

ABOUT THE AUTHOR

For many years, the author has been in charge of the Game and Fish Department habitat development program, with particular emphasis on the less-known species of shrubs, grasses and legumes.

by GLENN KINGHORN

REPRINTED FROM "COLORADO OUTDOORS", MAY–JUNE '56

Mr. John Farmer,
Star Route, Prairie View, Colo.

Dear John: So you want to landscape your farm "for the birds." By "the birds" I assume you mean pheasants, not the "city birds" who chase them; and I assume that you want both beauty and some wind protection as well.

If you want wildlife around, why not include other upland game—rabbits, quail, mourning doves—and maybe a few deer? You know there are now wild deer in every county in Colorado. Might as well grow your own, what?

. . . and you didn't tell me too much about the farm you wish to landscape. I assume it's in the eastern half of Colorado, probably dryland. If it's irrigated, any good nurseryman can help you. There are hundreds of plants that will thrive with irrigation. I'll get to them later.

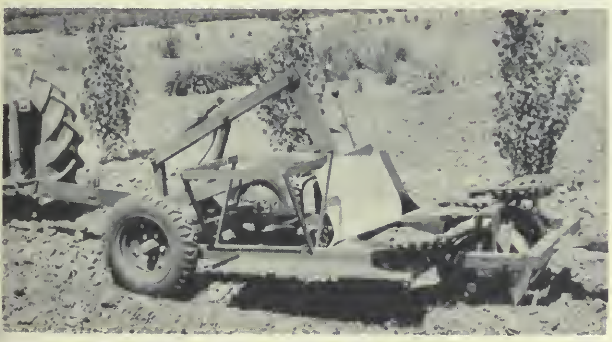
If your farm is on the dryland that's a "goose with different markings." Any kind of a planting on dryland calls for extra care and planning. That area—the eastern 40 percent of Colorado—is part of what John C. Calhoun called the "Great American Desert." Homestead acts, timberclaim acts, and numerous other methods were tried to encourage development of the drylands.

Books have been written, Mr. Farmer, about what happened to your dry farm, and the difficulty it had in becoming a farm, but little attention has been given to what happened to the game that called it home a century ago.

The chance to help make it a home for game and birds intrigues me very much. While you're doing that, you can also add improvements that will mean dollars to you in many other ways:

1. Landscaping around your buildings will add greatly to their appearance, hence to their value. (I'll quote some figures for you sometime—they're astounding.)

2. Protection from wind and storms will pre-



Planting machines have been developed in recent years which can be trailed behind any vehicle and which can be adjusted to any planting depth down to 15 or 16 inches.

Species of crabapples have reached four feet in two growing seasons and withstood drouth, jackrabbits and winds, but they had very careful cultivation and were kept free from weed competition.

Farmers on the Canadian prairies have learned to stop blowing snow and pile it up on their lands for the benefit of their crops. They cross-plant their fields—checkerboarding is one term often used up there—and have reduced winds as much as three-fourths, cut soil blowing and evaporation. They learned to live with the climatic conditions. The province of Saskatchewan has provided as high as 205 million seedlings per year to a total of 100,000 farm units during the past 55 years.

vent livestock losses almost sufficient to pay for the windbreak developments.

3. Windbreaks and cross-field plantings, like they make in Canada, will eliminate soil blowing, during dry years, pile up *your* snow and a lot of that from your neighbor's farm on *your* farm, instead of allowing it to blow on into Kansas or Oklahoma. You could add 6 to 10 inches of moisture to your land almost any year, simply by trapping the snow that falls plus that which blows over your farm. Think of the insurance on crops from that much more moisture! In wet cycles you might be able to eliminate a whole year of summer fallowing.

4. * * * and think of the extra food and cover such plantings would make for pheasants, quail, rabbits, doves, and we mustn't forget the deer for they'll be there when the cover and browse get thick enough. Heck! You might be selling one day hunting permits at a dollar a throw before too long—and with the kind of hunting you might create, sportsmen would be glad to pay it!

5. With all those trees and shrubs, think of the haven for songbirds! They would come in handy in controlling insect pests on your crops.

6. Don't overlook the chances of getting a lot of fruit trees and shrubs in your plantings. Your place could be a mighty popular farm on weekends—let your neighbors pick fruit on shares and you could go fishing and still keep the Missus busy canning.

If you like asparagus, try some in the rows between the trees. It does very well, stops blowing in sandy soils, and birds like the seed. After the second season you should have enough to freeze for your winter supply.

Now—are you satisfied that your idea is even better than you thought? If you are, let's get down to planning it.

First, if you don't have plenty of water you'd better summer fallow all areas to be planted. Store up enough moisture to assure that the trees and shrubs can grow. The first week or 10 days after transplanting is the critical period for any plant.

Second, visit your local nurseryman or county agent. Get his advice. Make a detailed plan so you'll know what comes next—you probably won't be able to do everything the first year. Then order your plants for delivery when you are ready for them. For your plantings around the house you will want larger stock and can get it the first year. For your field plantings it may take a year for the nurseryman to grow or secure the seedlings. Get your order in early.

Actually, Mr. Farmer, there are so many ways of landscaping your farm that I don't know where to start. So many things are involved: kind and depth of soil; average rainfall in your area; slope of your land and its drainage; direction of prevailing winds; size of your cultivating equipment—see what I mean?

Suppose we try to strike an average. You want a windbreak on the windward side of your home and farm buildings. Keep it far enough away—at least 200 feet—so it won't pile the snow right against your house, or machine sheds or into your corrals during blizzards. Be sure to leave a 15-

or 20-foot strip on both sides for a fireguard—and keep it clean!

I suggest at least 3 rows; 5 would be better. I'm enclosing a little sketch listing some of the plants you might try. You've got a wide choice of low shrubs for the outside (or windward) row. You may alternate various species, but they should be planted 2 or 3 feet apart. They will form the low "skirt" for your windbreak and "slowup" ground blizzards that are so frequent in your region.

The second row should be of taller shrubs or small trees, 12 to 16 feet inside the first row. Plants should be spaced 10 to 15 feet apart.

In a 3-row planting the inside row—about 16 to 20 feet from the second—might consist of shrubs similar to the outside, but I prefer evergreens—either pines or Colorado blue spruces and Rocky Mountain red cedars. They should be 10 to 12 feet apart to make a dense planting when they get larger. Spruces take a little more water, but they are worth it.

In case you wish a 5-row windbreak, the center row should be at least 20 feet from those on either side. I might mention that of those species mentioned on the sketch, hackberry is best, but a slow grower; Siberian elm grows fast, but breaks under snow and isn't too winter hardy; and cottonless cottonwoods are O. K. only if you have plenty of water or a high watertable. The plants should be at least 20 feet apart.

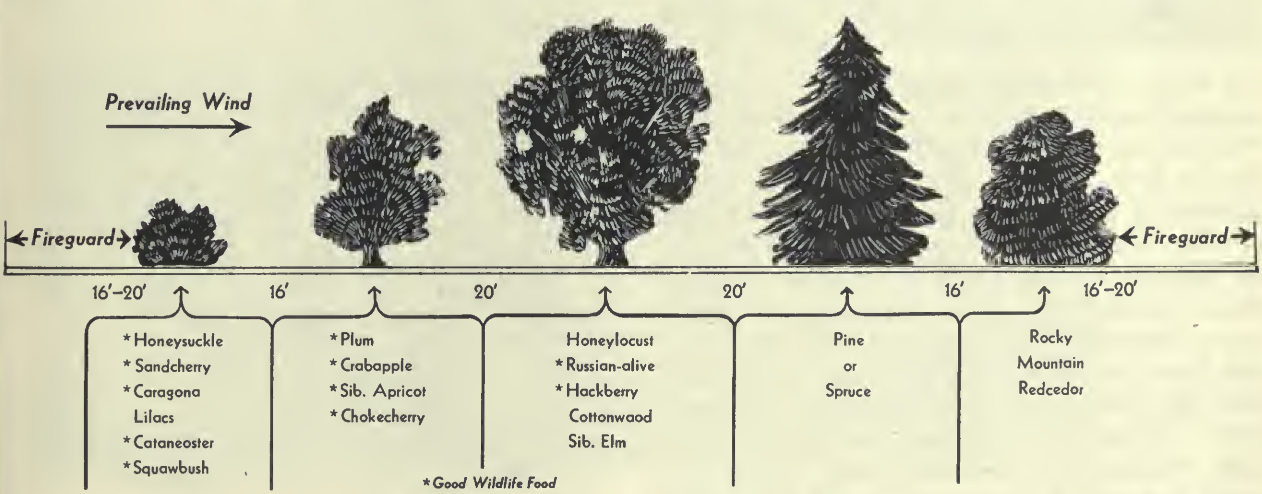
The fourth row could consist of some of the smaller trees or taller shrubs used in the second row, but I prefer to use evergreens in both the inside rows—pines or spruces in the fourth row and red cedars in the fifth, on the side toward the house. That gives the evergreens the protection of the other three rows while they are getting established, and the extra snow that would be piled up around them in the wintertime would almost guarantee their making excellent growth.

Anyhow—it will be those inside rows you will see from your home. Why not have a nice evergreen windbreak to look at the year 'round? Then, too, ever notice how pheasants and quail love evergreens, especially in the winter? They would be holding conventions right in your own front yard—visible from your picture window.

And deer? I almost forgot. They'll be there, too. I well remember an old doe and her fawn that lived in my plum thicket not over 75 yards from my back door on the farm. They kept the falling apples cleaned up each fall, jumped the fence and got fat in the neighbor's cornfields, but returned to the thicket each evening for their fruit.

Of course, your planting is one thing, and taking care of it is another. Don't line out more planting than you can keep cultivated and clean of weeds. If you can haul water to the tiny seedlings a few times the first spring, that will help them get started right. Everything depends on that first 2 or 3 weeks after planting. Those species I mentioned above are very resistant to drouth, and will start easier than most others. But—until they get started to grow, you have nothing.

Competition from weeds and lack of cultivation have killed millions of seedlings that have been planted on farms all over eastern Colorado—and, for that matter, up and down the High Plains of



Here's a closeup of a 5-ROW PLANTING.

Top Photo: Colorado blue spruce, Rocky Mountain redcedar and Western yellow pine—planted in 1923 on the high plains of eastern Colorado and spaced 16 by 16 feet, have withstood two severe periods of drouth, formed a considerable area of forest floor, and provided cover and some food for uncounted hundreds of game birds and animals. Immediately above: Native plum, choke cherry, Siberian apricots and crabapples are doing fine on sandy soils south of Akron, Colo. Note older planting of hackberry and elm at extreme right. At right: Dwarf caragana and honeysuckle, with Siberian elms between, have withstood 3 years of drouth (2- to 5-inch rainfall) mainly due to excellent, clean cultivation.

At left: Squawbush, plum and elm, with Russian olive and caragana on inside, have formed a good windbreak in 5 years in east-central Colorado— right in the heart of the drouth area. Below: Siberian apricot not only produces a goodly supply of fruit about every other year, but it makes a beautiful small tree or large shrub for the second row of a dryland planting. Note native plum at extreme left. Bottom photo: Sandcherry, native plum and Siberian elm are thriving early in their growing season, in spite of drouth.

the Dakotas, Montana, Eastern Wyoming, Western Nebraska, and Kansas. I suspect that not over 2 percent of what homesteaders and others have planted has grown. But those that have been given good care, even in drouth years, have survived, grown into sturdy specimens, and made HOMES out of what used to be only homesteaders' "soddies" or farmers' houses.

Another idea before I close, Mr. Farmer. The way those Canadian farmers have stopped the winds and piled up the snow on those vast prairie lands to the north of us! You can see from the photos I'm enclosing that they've carried it 'way past the experimental stage. It's amazing what crops they are growing up there where the snows never used to stop until they reached the wooded areas of eastern Manitoba and Ontario.

Single rows of caragana, interspersed with Manitoba maple (we call it boxelder) planted every 20 to 40 rods across great fields—making a giant checkerboard of the area—have done wonders. The Dominion Government ran tests which showed that *the wind velocity could be reduced by four-fifths at a distance of 50 feet inside a 1-row planting*, and even by one-fourth at 250 feet from it. The farmers started in earnest about 30 years ago and now are planting millions of seedlings each year.

It's an idea! You might try some honeysuckles or caragana or possibly some of the hardier crabapples to break up the wind out in your fields. Leave enough room at the ends of the rows to move your machinery from field to field.

In the event that you may wish to put your wildlife or windbreak plantings on some of your irrigated land, let's look at points which should be considered:

1. Don't overlook the fact that water costs money in our Western States. Use those species of plants which don't require too much water yet which grow rapidly under reasonable irrigation and reach utility size within 2 or 3 years. In my opinion the cost of extra water needed for good windbreaks is money well spent but some folks disagree.

2. You can use closer spacing between rows under irrigation than on the drylands—just wide enough to permit each species to develop without crowding or being crowded by adjacent plants. Be sure your cultivating equipment works well in the row-spacing you select.

Ponderosa or Western Yellow Pine have grown to 5 and 6 feet in almost pure (blow) sand in 6 years.

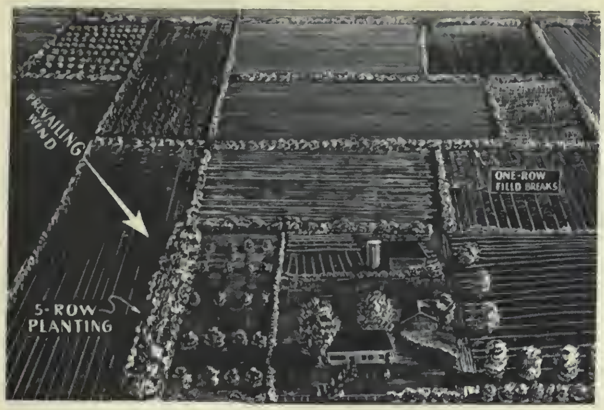
3. A much greater selection of species is available to you where you can irrigate. Consult your local nurseryman, county agent or some of the technicians with the Bureau of Reclamation, Soil Conservation Service or your Game and Fish department. Include some commercial varieties of fruits in those center rows—apples, cherries, plums, apricots, pears, peaches, etc. You might even plant 1 or 2 rows of grapes on the inside. You see the possibilities are much greater for variety when you have irrigation water.

4. One word of caution—don't irrigate your planting too late in the summer. I find that 6 to 8 weeks before first frost will keep the plants in good condition until time for them to go dormant.

Now—just a few odds and ends.

You want pheasants. Contrary to what some folks would have us believe, pheasants love to be around people, if they are not disturbed too much and frightened. I have had them eat with my chickens right in the barnyard. Aerial censuses in South Dakota showed a high proportion of the pheasants actually using shelter adjacent to farmyards.

So—no matter where you make your farm landscape plantings, if they are dense enough and provide protection from storms, you will have bird cover, and sooner or later the birds will find it. And if you want the right species of trees and shrubs there will be plenty of winter food with which they can supplement their daily ration of waste grain from your fields. Several of my good friends who also like to have plenty of birds



AERIAL VIEW of typical planting plan.

around have been leaving strips of grain or other seed crop around the edges of their fields just for the birds. It really pays off in "birds in the bag."

Heck—I've just touched the high spots of the questions you raised.

Some day when you have the time, make a simple sketch of your place. Put on the exact dimensions from buildings to roads, drives, fields, etc. Let me know something about your rainfall, soils, etc., and I'll work out a detailed plan for you.

Or—if you're in a hurry, talk with your nurseryman or county agent or both. And in any case, good luck!

Yours for more birds, better hunting, and a buck next fall,

Glenn Kingham

P. S.—I'm enclosing a couple of sketches—kind'a rough but they may help you with your plans—showing how the finished plantings might look on your place. Also, some pictures of what others have been able to do with trees and shrubs.

Incidentally this SOIL BANK with its Conservation Reserve feature looks like a boon to the farmer who wishes to make a windbreak or wildlife planting. It pays for land preparation, for the planting stock, and for the cultivation for 1 or 2 years. I don't know the regulations in each State but in Colorado these payments are quite substantial—from 50 to 75 percent of the actual cost—and that's a definite help. I understand that most of the Game and Fish departments in the Western States are cooperating with the administrators of the Soil Bank so it might be a good idea to contact them. Through the Federal Pittman-Robertson Act, each State's Wildlife Conservation department is helping the sportsmen to improve game habitat of all kinds. Certainly they can furnish the technical help you will need to plan your improvements properly and they might also have suggestions for getting substantial financial help in landscaping your farm "for the birds."—K.

The Editor's Column

The following facts have been gleaned from the United States Department of Agriculture's statistical summary, dated November 1956. We hope that you find them helpful.

Heavy supplies and strong demand again characterize the farm market this fall. Export prospects are good, notably in cotton, citrus fruits, wheat, and fats, and oils. Contributing are prosperity abroad, failure of some foreign crops, and Government export programs.

Domestic consumers are spending 5 percent more for food this year than last and consumer income is expected to increase with continued expansion in economic activity.

All-crop total was estimated on October 1 at close to 1955 and only a shade below the 1948 peak. Production is continuing heavy in livestock and poultry and dairy products. Though heavy marketings have depressed prices in recent months, index of mid-September prices received by farmers was a little above a year ago.

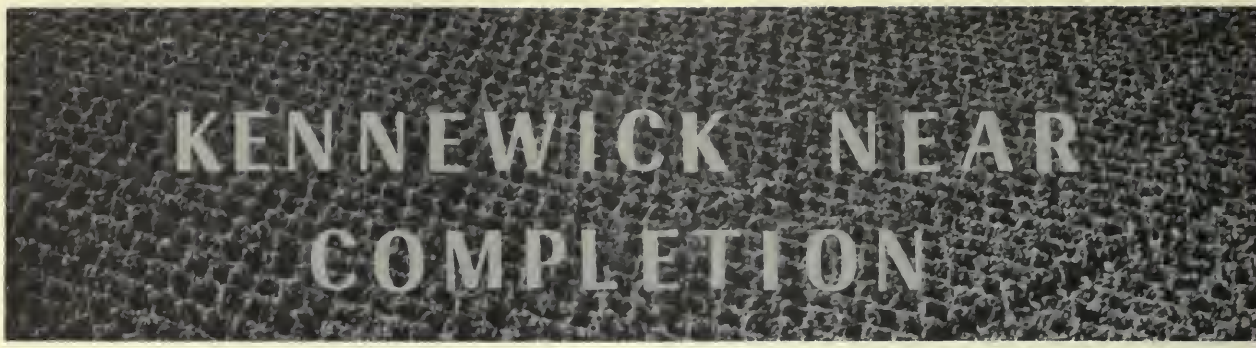
Fruit

Prices for oranges and deciduous fruits may run a little higher than last fall. Early and midseason orange crop is up 4 percent according to October estimates but exports are expected to increase. Deciduous production is down 1 percent with supplies of apples, grapes, and cranberries forecast smaller, but pears and dried prunes are higher.

Vegetables

With production up 16 percent, fall prices of fresh vegetables are expected to be somewhat lower than a year ago. Bigger supplies than in 1955–56 also are in view for processed vegetables. Farmers are expected to harvest 11 percent more

Continued on Page 20



KENNEWICK NEAR COMPLETION

by W. L. KARRER, Construction Engineer, Kennewick Division
Bureau of Reclamation, Kennewick, Washington

Major construction on the Kennewick Division of the Yakima Project in Washington drew to a close as this issue of the *Era* went to press. This Division is the fifth Division of the rich and fertile Yakima Project to be developed. As construction is practically completed, except for several miles of drains, studies are under way to assess the present feasibility of providing irrigation water to some 6,700 acres, which although an integral part of the project, were deferred during the original construction for later development.

Over half a century of dreams, plans, and hard work is represented in the Kennewick Division. At the turn of the twentieth century, private interests planned ways to bring irrigation water to the lands in the Division area. Even today traces remain of the work done by horse-drawn scrapers on the more easily constructed canal stretches. In 1912 the Northern Pacific Railroad made plans for irrigating the area, but did not follow through. Studies of the potential development were initiated by the Bureau of Reclamation in 1916, but the Division did not prove economically justifiable until the addition in 1946 of the Chandler Powerplant to the Project plan.

Construction of the Kennewick Division was authorized by the Congress in 1948 on the basis of the plan of development advanced in the Bureau of Reclamation 1946 report. In 1952 construction funds were appropriated and construction was started early in 1953.

The Kennewick Division will supply water to 14,500 acres of new lands and will also provide a gravity supply to 4,600 acres of old irrigated lands within the Kennewick Irrigation District which are now served by electric pumps. The Division

Hundreds of rows of neatly kept Concord grapes in a vineyard near Kennewick. Photo by Pomeroy, Region 1.

Aerial view of Yakima River near Prosser, Wash., showing irrigated land in contrast to virgin sagebrush. Photo by Stan Rasmussen, Region 1.

area lies wholly in Benton County, Wash., at an elevation of 500 to 700 feet above sea level, and forms a strip about 1 mile wide extending from Chandler on the south side of the Yakima River in a southeasterly direction a distance of 50 miles. The lands lie near the Tri-Cities of Richland, Pasco, and Kennewick about 15 miles from the Hanford works of the Atomic Energy Commission. The Division is served by two railroads, by river navigation to the Pacific Ocean, and by an excellent highway system. An oil pipeline from Utah serves the area with liquid fuel, and a 21-inch natural gas line from Colorado has recently been placed in service.

The Division area is quite arid, receiving only 7 inches of moisture annually, and has a growing season of 210 days. Sunshine can be expected 90 percent of the time during the summer months. The soils are fine sandy loams, and since the irrigable lands generally are quite steep, much of the irrigation will be by sprinkler methods. Specialized crops such as asparagus, mint, grapes, and soft fruits will be the main crops grown.

Division lands were in the most part privately owned, but a part of the lands were in public ownership. These public lands were divided into 17 farm units, averaging slightly over 97 acres per unit, which were opened to homestead entry in June of this year. There were 774 applicants for the units and on June 22, 1956, a drawing was held to select the successful applicants. Persons whose names are drawn had to prove that they qualify for the homesteads to assure successful settlement of the units.

The water supply for the Kennewick Division comes from Yakima River storage and also from return flows from the 460,000 acres of irrigated land upstream. The system was designed for a diversion of 5 acre-feet per acre with an estimated 1.5 acre-foot loss through evaporation and percolation, leaving 3.5 acre-feet per acre delivered over the farm weir.

In 1932 the Kennewick Irrigation District, irrigating approximately 5,000 acres, entered into a contract with the Bureau of Reclamation to rehabilitate its distribution system and pumping plant. To supply the power for the pumps, a 2½ mile canal was constructed from the Prosser Division Dam to where a penstock dropped the water 40 feet developing power which had a name plate capacity of 2,400 kw at the Prosser Powerplant. This powerplant was abandoned following con-

PROSSER POWERPLANT. Photo by T. R. Smith.

CHANDLER POWER AND PUMPING PLANT.

struction of the 12,000 kilowatt Chandler Powerplant of the Kennewick Division.

At the Chandler forebay, penstocks drop the water 118 feet into the power and pumping plant that has two 6,000 kilowatt generator units, and two 167 cubic feet per second hydraulic pumps with provision for a third for future development for 6,700 acres in the deferred area, now under study.

The irrigation canal for the first 5 miles has a designed capacity of 500 cubic feet per second to care for the eventual development of the 6,700 deferred acres. This canal continues for 45 miles and follows along the north exposure and base of a low steep range of hills known as the "Horse Heavens." The two main laterals are the Badger East and the Highlands Feeder Lateral, the first being 16 miles and the second 5 miles in length. Since most of the area served lies on fairly steep slopes and in fine silty loam soils, the majority of sublaterals are in pipe.

A second hydraulic pump, 25 miles from the head of the irrigation canal, makes use of the falling head of water released to serve the district's 4,600 acres of old lands. This pump at the Amon Siphon lifts 20 cubic feet per second 175 feet in elevation and serves 1,000 acres of new lands.

RICHARD LEE'S mint farm has produced mint oil that brought him a gross profit of $700 per acre. Photo by Stan Rasmussen, Region 1.

To restore the salmon and steelhead runs in the Yakima River, two fish ladders are being constructed through the Prosser Diversion Dam, together with a complete rehabilitation of the present fish screens just downstream from the diversion works. The river channel, through the shallow riffle sections between Prosser and the Chandler power and pumping plant, will be deepened to concentrate the flow to provide better fish passage during low water periods. To better protect upland game, 25 miles of fencing is planned along the downstream toe of the irrigation canal, where bushes will be planted for winter shelter for birds. ###

FOUR STATES IRRIGATION COUNCIL MEETING

Floyd E. Dominy was a speaker at a luncheon meeting of the "Four States Irrigation Council," on January 10, 1957. The Council, composed primarily of representatives of irrigation organizations in the four States of Colorado, Kansas, Nebraska, and Wyoming, held its sixth annual meeting on January 10 and 11 at the Denver Federal Center. Mr. Dominy, who is Chief, Division of Irrigation, with headquarters in Washington, D. C., discussed irrigation development in the United States and also reported on Reclamation activities he studied on a recent trip to Holland.

R. J. Walter, Jr., Regional Director, Region 7, Denver, Colo., served as Director-at-Large at the request of the Council and assisted in arrangements and development of the program for the 2-day meeting. The program included a wide range of subjects on irrigation of particular interest to the group.

APPOINTMENTS AND RETIREMENTS

A. NORMAN MURRAY

R. S. CALLAND

ARTHUR B. REEVES

CHARLES H. CARTER

PALMER B. DeLONG

Five major personnel changes occurred in the Bureau's Denver and Regional offices in time to make this issue of the *Era.*

These include the appointments of three Assistant Regional Directors, the retirement of the Chief of the Division of Irrigation Operations in the Bureau's engineering office in Denver and the retirement of the Assistant Regional Director in Region 2.

Assistant Regional Director Robert S. Calland for Region 2, Sacramento, California, was succeeded by A. NORMAN MURRAY. Mr. Calland, a native of Summerfield, Ohio, and a graduate in Civil Engineering from Ohio State University, had been with the Bureau since 1914. Commissioner W. A. Dexheimer wrote to Mr. Calland "On the occasion of your retirement I want to commend you on your long service to the Bureau of Reclamation and your contribution to the resource development of the West."

MR. MURRAY, a graduate of Long Beach City College, received his degree in Civil Engineering at Washington State College. He had an active engineering career with private corporations prior to joining the Bureau in 1939. He has advanced steadily as an engineering administrator since he became associated with the Bureau including service with the Corps of Engineers in World War II, where he was assigned to work on the design and testing of military bridges. He was serving as Acting Assistant Regional Director at the time of his appointment.

He is a member of the American Society of Civil Engineers, and resides with Mrs. Murray and their two sons in Sacramento.

ARTHUR B. REEVES, Chief of the Division of Irrigation Operations in the Bureau's engineering office in Denver, retired from Government service, November 30. Although Mr. Reeves retired after 43 years of Government service, he actually began his distinguished career in 1910, almost 47 years ago, on the Bureau's North Platte Project in Nebraska, where, after construction of the project facilities had been completed, he served as Superintendent of the Goshen Irrigation District for 4 years.

He is a recognized authority in the field of irrigation engineering. The esteem with which he is held was attested to by the scores of letters he received on the occasion of his retirement acknowledging his accomplishments and his generous contributions to the careers of other engineers.

Mr. Reeves graduated as a civil engineer from Iowa State College in 1910. He is a member of the American Society of Civil Engineers and a member of the United States National Committee of the International Commission on Irrigation and Drainage. He is author of numerous technical articles and papers on the design and construction of irrigation facilities.

The appointments of Charles H. Carter and Palmer B. DeLong as Assistant Regional Directors for Region 4, Salt Lake City, were announced by E. O. Larson, Regional Director.

These appointments are part of the increased staffing required to handle the greatly expanded Reclamation program in Region 4. Construction is in progress on the Eden, Provo River and Weber Basin projects and has started on Glen Canyon and Flaming Gorge Dams, initial key structures in the comprehensive Colorado River Storage Project.

MR. CARTER was born in Vernal, Utah, and graduated from Utah State Agricultural College in Civil Engineering. He joined Reclamation at Echo Dam in 1928 and has completed 28 years in Government service. His assignments include 5 years in Denver on designs for some of the Bureau's largest dams and a year in the Commissioner's office in Washington. He was Office Engineer during construction of many Bureau projects in the State of Utah.

Mr. Carter has been Regional Engineer since 1946 and has also served as Acting Assistant Regional Director during the past two and one-half years.

MR. DeLONG, a native of northern Utah, received his Civil Engineering degree from the Utah State Agricultural College. He joined the Bureau as Junior Engineer at Green River, Wyoming, following graduation, and served in positions of increasing responsibility at various locations in Wyoming until 1946. He was then placed in charge of project investigations in the Green River Basin. Studies completed and project reports issued under his direction include the Seedskadee, Lyman and LaBarge participating projects recently authorized with the Colorado River Storage Project. Since 1950, in addition to his project planning activities, Mr. DeLong as head of the Rock Springs office has supervised construction of the Eden Project. ###

Editors Column

Continued from Page 15

potatoes this fall than last, and farm and retail prices are relatively low. Drop in sweetpotato production points to materially higher prices than for the 1955 crop.

Wool

Returns to producers will be above those of last year. Lower prices on the 1956 clip will be more than offset by incentive payments on the 1955 clip.

Livestock

Production of livestock and livestock products in 1956 will break a record for the eighth consecutive year. Hog production is down from last fall but beef output is close to last year's high. More cattle were placed on feed this summer than last, and sales of short-fed stock are likely to rise for the next few months. This points to seasonal price reductions for choice and prime steers. Mid-October hog prices were a little above a year ago. Hog prices probably will move down more slowly this fall than last.

Diary

Milk production is at a peak rate. Milk and butterfat prices are again increasing less than seasonally this fall but continue slightly above a year ago. Milk prices have gone up less than feed since last winter but milk-feed price ratio is still above average.

"Idaho
and its natural resources"

SPORT SCENES at Idaho's Sun Valley were filmed with this ski-mounted camera.

Idaho, with more reclamation project acreage than any other Western State, is the subject of a new 16-mm. motion picture in sound and color recently released by the Bureau of Mines, U. S. Department of the Interior.

Produced in cooperation with the Richfield Oil Corp., the film traces the development of the Gem State from the arrival of Lewis and Clark in 1805. It shows how integrated irrigation and power projects have paced the economic growth of Idaho and enabled it to become an important producer of farm and dairy products, minerals, and lumber. Colorful glimpses of snow-fed streams, lakes, and rivers emphasize the natural beauty and grandeur that have made the State a tourist's wonderland.

The 30-minute film includes informative sequences on mining and processing of zinc, lead, antimony, and many other minerals as well as farming scenes that show raising of the famed Idaho potato, sugar beets, and other principal crops on irrigated land. It also contains many authentic hunting and fishing scenes and a fast-moving skiing episode photographed at Sun Valley.

"Idaho and Its Natural Resources" is available on free short-term loan for showing to the Grange, water-users' associations, co-ops, 4–H clubs, civic groups, schools, colleges, and other organizations. Prospective borrowers should write to the Bureau of Mines, Graphic Services Section, 4800 Forbes Street, Pittsburgh 13, Pa.

Prints of "Idaho" also can be borrowed from the University of California, Extension Division, Department of Visual Education, Berkeley; University of California, Department of Visual Instruction, 405 Hilgard Avenue, Los Angeles 24; Idaho State College, Educational Film Library, Pocatello; Museum of New Mexico, Museum Film Service, School of American Research, Santa Fe; North Dakota Agricultural College, Division of Supervised Study, State College Station, Fargo; Oregon System of Higher Education, Department of Visual Instruction, Corvallis; Library Association of Portland, Portland, Oreg.; Texas Education Agency, Division of Curriculum Development, Austin; East Texas Bureau of Visual Education, Kilgore; West Texas Cooperative Audio-Visual Services, Texas Technological College, P. O. Box 4380, Lubbock; and University of Wyoming, Audio-Visual Teaching Aids, Laramie.

Some of the non-Bureau centers may make small service charges for use of the film. #

WOMEN VOLUNTEERS WANTED FOR ERA

The Secretary or some other officer of each and every organization of women on our projects is requested to take her pen or typewriter in hand and write to J. J. McCarthy, Editor of RECLAMATION ERA, *and outline her views as to how the* ERA *may best serve the interests of our project women. The same invitation is extended to every woman not connected with a women's organization.*

The ERA *wishes to be of service to everyone on the projects—men, women, boys, and girls. Just now the call is for women volunteers; without whose cooperation this proposed feature of the* ERA *cannot be a complete success. Write today!*

LARGEST RECLAMATION DEVELOPMENT

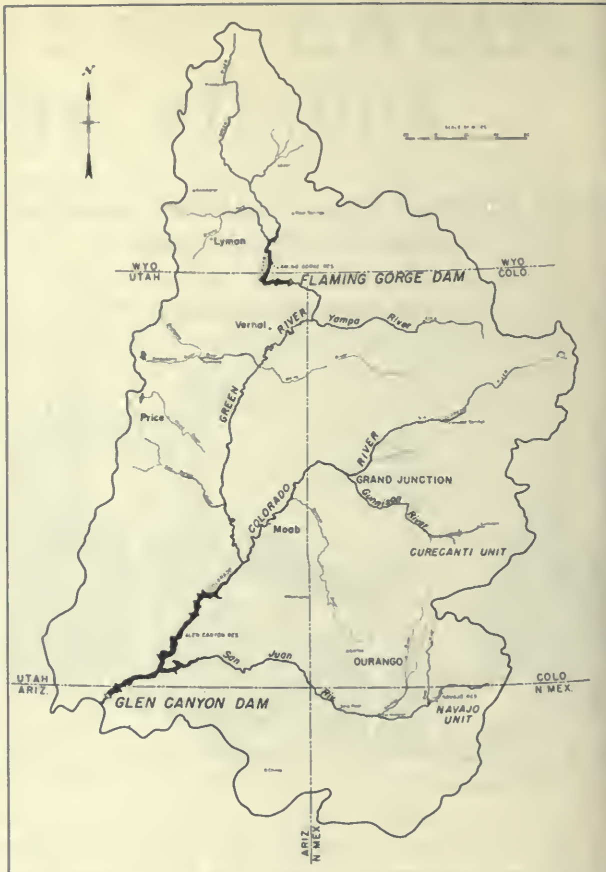
(Continued from p. 3)

River water under the proposed Navajo Irrigation Project, and the proposed San Juan-Chama Project.

Construction on the participating projects may commence in fiscal year 1958. Work could be started on the Seedskadee Project in Wyoming, the Paonia Project in Colorado, and the Vernal Unit of the Central Utah Project. Under an orderly program of development, 10 or more years may be required to get all 11 participating projects underway, and it may require up to 25 years to complete the more complicated phases of the large Seedskadee and Central Utah Projects.

The Congress, in authorizing the initiation of the Upper Colorado River development, declared that it was not its intention "to limit, restrict, or otherwise interfere with such comprehensive development as will provide for the consumptive use by States of the Upper Colorado River Basin" of their apportioned water. On the contrary, the Act directs the Secretary of the Interior to continue the investigations of additional units of the Colorado River Storage Project and the participating projects and to report the results of these investigations to the States, President, and the Congress. The Public Law 485 specifically lists 24 such projects for priority consideration.

The 4-storage units and the 11 participating projects authorized for construction constitute the nucleus of an overall basin plan to which subsequent additions will be authorized as the

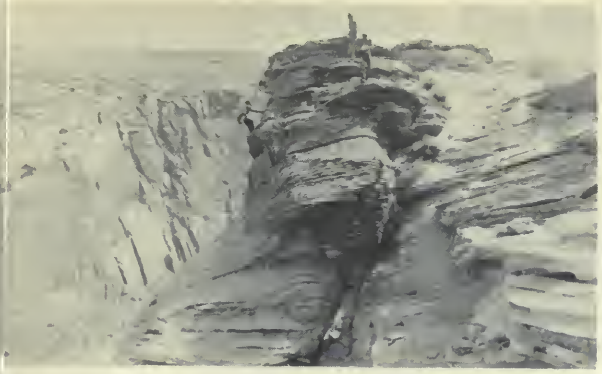


needs arise in the development and use of Colorado River water alloted to the Upper Basin by the Colorado River Compact of 1922. At the present time, the Upper Basin is consuming about 2½ million acre-feet of its annual allotment of 7½ million acre-feet. Completion of the features initially authorized by Public Law 485 will increase consumptive water use in the Upper Basin by about 1 million acre-feet, raising the total use to 3½ million acre-feet.

Except for very minor amounts allocated to recreation and flood control (less than 1 percent of the total) the entire construction cost of the Upper Colorado River development will be repaid by the water and power users of the Upper Basin during a period of 50 years after completion of construction of each unit or project. In addition, interest will be paid on the costs allocated to power and municipal water, which constitute about two-thirds of the estimated total construction costs.

Over a period of 50 years (except for the Paonia and Eden Projects whose repayment periods were set by previous law), the irrigators will repay

GLEN CANYON DAM site, October 1956.



HIGH SCALERS going over the top of right abutment—Glen Canyon Dam site.

that portion of the direct irrigation costs which is within their repayment ability. That part of the irrigation costs above the irrigators ability to repay within their respective repayment periods will be repaid from power revenues.

Power revenues in excess of those required to repay direct power costs—construction, O & M, interest, etc., will be used through a Basin Fund to assist irrigation developments in the Upper Basin States as follows: 46 percent to Colorado, 21½ percent to Utah, 15½ percent to Wyoming, and 17 percent to New Mexico.

The prospective credits to the Basin Fund from the initial storage and power units will be ample to provide the financial assistance needed by the initial group of participating projects.

In summarizing the importance of the basin-wide development program for the Upper Colorado River, Commissioner of Reclamation, W. A. Dexheimer, recently stated:

"*These things can be done at reasonable cost and are good investments whether done by local people, the States, or the Federal Government. The returns in stable, prosperous farms and communities; the returns in business and industrial activity; and the returns in local, State and Federal taxes will more than pay the cost of Upper Colorado River development in a very short period of years. In addition, we will have opportunities for recreation so vitally needed for our enjoyment of better living and particularly needed to accommodate a growing population with more leisure time, paid vacations, and early retirement.*

"*Whether you view the water conservation and development features of this program as farmers, industrialists, retailers, or just plain vacationers, I think you will find they are very worthwhile.*"

SHASTA LAKE REFORESTATION

Reforestation and erosion control on denuded areas in the mountains surrounding Shasta Lake will be accomplished under a recently announced cooperative agreement between the Bureau of Reclamation of the United States Department of the Interior and the Forest Service of the United States Department of Agriculture.

In making known this joint effort, Regional Director Clyde H. Spencer, of the Bureau, and Regional Forester Charles A. Connaughton, stated that the particular area involved is on the western shore of the lake. They stated the principal purpose to be accomplished is to provide forest cover and small dam-like structures aimed at preventing the further erosion of soil into the lake, which is the 4,500,000 acre-feet capacity reservoir impounded by Shasta Dam.

The barren condition of the area dates back to the time when the old mining town of Kennett, now covered by several hundred feet of water, was the center of an extensive copper smelting operation. Toxic fumes from the smelter killed off the trees and other vegetation on the slopes and poisoned the ground. For many years the bare slopes retained enough poisons to prevent any appreciable vegetation taking hold. Year after year the soil was washed by heavy winter rains into the gullies and canyons, and more recently, into the lake. At the present time the ground has been cleared of poisons sufficiently to allow the reestablishment of forest cover.

Subject to congressional appropriations, the work will extend over a period of 5 years, until June 30, 1962, and is expected to cost between $75,000 and $80,000 per year.

Since National Forest lands are involved, the work is to be planned and performed by the Forest Service, subject to review by the Bureau of Reclamation, and with funds made available by that agency. It will follow the general pattern of watershed reclamation and treatment accomplished earlier by the Bureau of Reclamation on the denuded slopes in the vicinity of Keswick Reservoir.

The program is scheduled to get under way next year with planting. The installation of erosion control structures will follow as rapidly as they can be planned and placed. Field work will be under the direction of Forest Supervisor Paul W. Stathem, Shasta-Trinity National Forests.

MAJOR RECENT CONTRACT AWARDS

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DC-4602	Parker-Davis, Arizona-California.	Dec. 7	Construction of a multi-channel microwave radio communication system between Phoenix, Ariz., and Parker Dam, Calif.	Westinghouse Electric Corp., Phoenix, Ariz.	$209, 593
DC-4697	Missouri River Basin, Wyo.	Oct. 25	Completion of Glendo powerplant and switchyard	Eagle Construction Corp., Loveland, Colo.	1, 120, 447
DS-4712	Weber Basin, Utah	Nov. 28	One 2,000-hp and two 2,900-hp vertical-shaft, hydraulic turbines for Wanship and Gateway powerplants.	James Leffel and Co., Springfield, Ohio.	190, 000
DS-4713	Weber Basin, Utah	Oct. 10	One 1,500-kva and two 2,250-kva vertical-shaft generators for Wanship and Gateway powerplants.	Electric Machinery Mfg. Co., Minneapolis, Minn.	172, 194
DS-4723	Chief Joseph Dam, Wash.	Oct. 4	Four horizontal, centrifugal-type pumping units for Brewster Flat pumping plants, Schedule 2.	C. H. Wheeler Mfg. Co. Economy Pump Division, Philadelphia, Pa.	55, 456
DC-4733	Solano, Calif	Oct. 5	Construction of earthwork, concrete canal lining, and structures for Putah South Canal, Sta. 338+85.12 to 1017+00; and McCoy Creek wasteway.	Vinson Construction Co., Phoenix, Ariz.	2, 143, 907
DC-4736	Columbia Basin, Wash	Sept. 28	Construction of earthwork, concrete lining, and structures for Burbank canal laterals, Block 3.	Lewis Hopkins Co., Pasco, Wash.	302, 708
DC-4738	Middle Rio Grande, N. Mex.	Oct. 10	Construction of earthwork, clearing, and structures for irrigation rehabilitation of Belen Unit 1.	Richey Construction Co., St. Johns, Ariz.	156, 355
DC-4739	do	Oct. 24	Construction of earthwork, clearing and structures for irrigation rehabilitation of North part of Socorro Unit 1, Schedule 1A.	Badger Lynch, Albuquerque, N. Mex.	146, 728
DC-4739	do	do	Construction of earthwork, clearing and structures for irrigation rehabilitation of North part of Socorro Unit 2, Schedule 2A.	Joseph C. Hastings, Albuquerque, N. Mex.	102, 321
DC-4739	do	Oct. 25	Construction of earthwork, clearing, and structures for irrigation rehabilitation of the South parts of Socorro Units 1 and 2, Schedules 1B and 2B.	J. F. Schroeder Sons, Ordway, Colo.	256, 819
DS-4745	Colorado River Front Works and Levee System, Arizona-California-Nevada.	Nov. 6	One 12-inch hydraulic suction dredge for Lower Colorado River.	Commercial Steel Fabricators, Inc., Seattle, Wash.	234, 700
DC-4747	Colorado River Storage, Arizona-Utah.	Oct. 1	Construction of right diversion tunnel for Glen Canyon Dam.	Mountain States Construction Co., Denver, Colo.	2, 452, 340
DC-4749	Columbia Basin, Wash	Oct. 10	Construction of radial gate check drop for Potholes East canal, Sta. 1369+11.	Cherf Brothers, Inc., and Sandkay Contractors, Inc., Ephrata, Wash.	108, 580
DC-4750	Missouri River Basin, Wyo.	Nov. 16	Two 33,500-hp, vertical-shaft hydraulic turbines for Fremont Canyon powerplant.	Newport News Shipbuilding & Dry Dock Co., Newport News, Va.	608, 750
DC-4751	Central Valley, Calif	Oct. 19	Construction of Trinity River bridge superstructure on the county road relocation, Sta. 5+55 to 8+50.	Bos Construction Co., Berkeley, Calif.	135, 860
DS-4753	Ventura River, Calif	Oct. 30	Steel pipe for Casitas Dam	Kaiser Steel Corp., Fabricating Division, Napa, Calif.	141, 776
DC-4756	Colorado River Storage, Arizona-Utah.	do	Construction of earthwork and structures for Waterholes Canyon bridge and 20 miles of access highway for Glen Canyon dam.	W. W. Clyde and Co., Springville, Utah.	1, 011, 820
DC-4758	Columbia Basin, Wash	Oct. 25	Construction of earthwork and structures for Block 79 laterals and wasteways, West canal laterals.	Henly Construction Co., Inc., Yakima, Wash.	437, 864
DS-4760	Rogue River Basin, Oreg.	Nov. 30	One 23,500-hp, 600-rpm, vertical-shaft, hydraulic turbine; one governor; guard valve; and inlet pipe for Green Springs powerplant.	Allis-Chalmers Mfg. Co., Denver, Colo.	373, 245
DC-4762	Central Valley, Calif	Nov. 26	Construction of earthwork, structures, and surfacing for connecting access road from Highway 299 to Trinity River crossing.	Monte W. Brown, Redding, Calif.	696, 867
DC-4763	Solano, Calif	Nov. 26	Construction of county road bridge over Putah diversion dam pool.	C. S. Phillips Construction Co., Inc., Petaluma, Calif.	112, 530
DC-4766	Chief Joseph Dam, Wash.	Dec. 12	Construction of Brewster Flat pumping plants, discharge lines, and switchyards.	Ward Construction Co., and Alton V. Phillips, Seattle, Wash.	847, 584
DC-4767	Columbia Basin, Wash	Nov. 27	Construction of White Bluffs pumping plant No. 1, switchyard, laterals, and discharge lines, Block 20.	Syblon-Reid Construction Co., Warden, Wash.	235, 146
DC-4768	Weber Basin, Utah	Nov. 28	Construction of Wanship and Gateway powerplants and switchyards.	Davis and Butler Construction Co., Salt Lake City, Utah.	445, 093
D-4771	Chief Joseph Dam, Wash.	Dec. 13	One 2,400-volt motor control equipment assembly for the booster pumping plant of the Brewster Flat pumping plants.	Cutler-Hammer, Inc., Denver, Colo.	46, 990
DS-4772	Missouri River Basin, S. Dak.	Dec. 18	Two 230-kv power circuit breakers for Sioux City substation	Brown Boveri Corp., New York.	104, 450
DC-4782	Missouri River Basin, Mont.	Dec. 27	Construction of Helena Valley tunnel and canal, Sta. 3+14.30 to 149+00.	Guy H. James Construction Co., Oklahoma City, Okla.	2, 095, 041
DC-4796	Rio Grande, N. Mex	Dec. 10	Reconductoring 72 miles of Elephant Butte-Socorro 115-kv transmission line.	Lively Electric Co., Borger, Tex.	235, 386
100C-259	Minidoka, Idaho	Oct. 3	Construction of two 3-bedroom and two 2-bedroom residences and warehouse for Unit A pumping plant, and near Rupert, Idaho.	Wright Brothers, Rupert, Idaho.	64, 820
100C-262	do	do	Construction of open drains for Unit A; and Group 4 of Unit B	Duffy Reed Construction Co., Twin Falls, Idaho.	159, 044
100S-263	do	Nov. 16	Deep well pumping units for 17 wells	Layne and Bowler Pump Co., Los Angeles, Calif.	165, 045
117C-388	Columbia Basin, Wash	Oct. 3	Construction of Grand Coulee Dam tour center	Ruud Construction Co., Spokane, Wash.	92, 150
117C-402	do	Nov. 15	Construction of compacted earth lining for reaches of existing lateral EL68 and construction of culvert, Block 45.	Cherf Brothers, Inc. and Sandkay Contractors, Inc., Ephrata, Wash.	198, 489
200C-326	Central Valley, Calif	Oct. 1	Constructing foundations and furnishing and erecting prefabricated metal auto shop and vehicle storage buildings for Tracy pumping plant and switchyard.	J. L. Webster, Galt, Calif	99, 984
400C-68	Colorado River Storage, Arizona-Utah.	Nov. 8	Completion of gravel surfacing from the Arizona-Utah state line to Glen Canyon dam site, Wahweap Creek road, and construction of airstrip.	Ford-Fielding, Inc., Provo, Utah.	36, 801
400C-71	Weber Basin, Utah	Oct. 2	Construction of earthwork for stabilization of slide areas on Gateway canal, Sta. 342+00, 358+00, and 397+50.	Fife Construction Co., Brigham City, Utah.	71, [illegible]93
400C-73	Weber Basin, Utah	Nov. 28	Construction of recreation area access road and livestock road relocation for Wanship reservoir.	R. M. Jensen, Contractor, Salt Lake City, Utah.	76, 312

Construction and Material for Which Bids Will Be Requested Through March 1957 [1]

Project	Description of work or material
Central Valley, Calif.	Pinning loose rock on the Folsom Powerplant tailrace channel wall and extending the concrete training wall. Near Folsom.
Chief Joseph Dam, Wash.	Constructing the Brewster Flat Distribution System will include 8,000 feet of 4- to 30-inch steel pipe, 12,000 feet of 4- to 12-inch asbestos-cement pipe and appurtenant structures. Near Brewster.
Colorado-Big Thompson, Colorado.	Constructing an outdoor-type powerhouse with a reinforced concrete substructure, installing a 6,300-horsepower turbine and a 4,500-kw generator, and constructing a reinforced concrete intake structure and an access road. Near Loveland.
Colorado River Storage, Arizona.	Constructing the 700-foot-high concrete arch Glen Canyon Dam with a 1,500-foot-long crest, excavating and lining with concrete a diversion tunnel on the left side of the river 41 feet in diameter and 2,900 feet long, and constructing an indoor-type powerplant 665 feet long, 112 feet wide, and 160 feet high, located about 500 feet downstream from the axis of the dam. The powerplant substructure and intermediate structure is to be of reinforced concrete and the superstructure of structural steel with concrete enclosure. On the Colorado River, about 125 miles north of Flagstaff.
Do	Furnishing and erecting one 2,000,000-gallon elevated steel water tank with a minimum water surface of 55 feet above footings for the Glen Canyon Community facilities, about 125 miles north of Flagstaff.
Do	Constructing about 290 residences and facilities for a a 2,000-person community at Glen Canyon. About 125 miles north of Flagstaff, Arizona, and 70 miles east of Kanab, Utah.
Colorado River Storage, Utah.	Excavating in open cut and in tunnel for the 1,350-foot-long, 26-foot-diameter unlined right abutment diversion tunnel at the Flaming Gorge Dam site. On the Green River, 40 miles north of Vernal.
Columbia Basin, Wash.	Earthwork and structures for about 4 miles of unreinforced concrete-lined canal with a 12-foot bottom width and about 3 miles of unlined canal with a 36-foot bottom width. Wahluke Canal, 9 miles south of Othello.
Do	Earthwork and structures for about 85 miles of laterals and wasteways, and constructing 8 minor relift pumping plants. 10 miles northwest of Mesa.
Do	Earthwork and structures for about 80 miles of unlined laterals, wasteways and drains with bottom widths varying from 14 to 2 feet. About 10 miles northeast of Beverly.
Do	Constructing DW38, 33, 36, 38A and W654D drains. Block 72, near Quincy.
Do	Constructing about 3.5 miles of deep and semi-deep drains on the DE44.5 system. Block 43, near Warden.
Do	Constructing 6 open drains on the DE229 lateral system in Blocks 41 and 42, near Moses Lake.
Do	Constructing 3 drains on the DW36 and DW35.8G systems in Block 72, near Quincy.
Do	Constructing the DPE221A drain, extending 3 deep drains on the DPE216 system in Block 49, and constructing the DPE224C drain in Block 11, near Othello.
Do	Deepening about 2.5 miles of DE229 drain, extending 2 culverts, reconstructing about 12 drain inlets, deepening about one mile of EL31 wasteway, and removing and reconstructing a county road bridge in Block 42; deepening 8 drains in Blocks 41 and 42; and constructing about one mile of deep and semi-deep drains on the DE53.5 and DE53.5A systems; constructing a road crossing and 3 pipe drain inlets in Block 43. Near Warden and Moses Lake.
Do	Deepening one drain, constructing 7 new drains, 2 wasteways, and one pumping plant in Block 45, near Othello.
Do	Furnishing, placing and stockpiling gravel for road surfacing in Block 18, near Connell.
Do	One 3-phase, 2,000-kva, 13.2-kv delta to 2.4-kv delta, class OA, outdoor power transformer with 3 high-voltage, station-type, tank-mounted lightning arresters for White Bluffs Pumping Plant No. 1.
Do	One indoor, 2,500-volt, full-voltage starting controller for four 600-horsepower synchronous motors for White Bluffs Pumping Plant No. 1.
Eklutna, Alaska	Constructing a 34.5-kv bay at Anchorage Substation. Work will include constructing concrete foundations, furnishing and erecting steel structures and a one-day extension of existing 34.5-kv bus structure, and installing a 34.5-kv circuit breaker and associated electrical equipment. Near Anchorage.
Do	One duplex-type control board panel for the Anchorage Substation.
Gila, Ariz	One synchronous, motor-driven, vertical-shaft, centrifugal-type pumping unit with a capacity of 275 cfs at a total head of 54 feet for the Yuma-Mesa Pumping Plant.
Do	One duplex-type control board panel for the Casper Substation.
Michaud Flats, Idaho.	Constructing 7.5 miles of welded steel pipe laterals for sprinkler-type irrigation. Near American Falls.
Minidoka, Idaho	Earthwork and structures for about 7 miles of open laterals with bottom widths of from 4 to 2 feet, from 14 wells. Near Rupert.
Do	Additional drilling on eleven 8-, 12-, and 16-inch-diameter drainage wells, and drilling and casing four 16- and 20-inch drainage wells with depths of from 200 to 400 feet. Near Rupert.
MRB, Kansas	Constructing the 2,150-foot-long earthfill Woodston Diversion Dam with concrete ungated overflow spillway 150 feet long, gated sluiceway, and gated canal headworks involving placement of about 1,800 cubic yards of concrete. On the South Fork of the Solomon River about 9 miles west of Woodston.
Do	Earthwork and structures for about 10 miles of Courtland West Canal with bottom widths varying from 12 to 6 feet and about 28.5 miles of open laterals. Near Courtland.
MRB, Montana	Constructing the 75-foot-high, 2,800-foot-long earthfill Helena Valley Dam with outlet works for municipal water supply, canal headworks, and about one mile of operation and maintenance road. About 6 miles northeast of Helena.
Do	Four 7-foot 2-inch by 4-foot 8-inch bulkhead gates, seats and guides for turbine draft tube. Estimated weight: 5,875 pounds each. For Helena Valley Pumping Plant.
Do	One hydraulically-operated cylinder hoist for a 12.78- by 21.78-foot fixed-wheel gate. Estimated weight: 20,000 pounds. For Helena Valley Pumping Plant.
Do	One hydraulic control system for fixed-wheel gate hoist consisting of high-pressure oil pump, pipe fittings and valves, and necessary electric controls enclosed in a metal cabinet. Estimated weight: 3,000 pounds. For Helena Valley Pumping Plant.
Do	One hydraulic control system for 2 butterfly valves consisting of high-pressure oil pump, pipe fittings and valves, and necessary electric controls enclosed in a metal cabinet. Estimated weight: 5,000 pounds. For Helena Valley Pumping Plant.
Do	Three 5,000-kva, 110–69–34.5-kv mobile autotransformers complete with trailers.
MRB, Nebraska	Earthwork and structures for about 13.5 miles of canal with bottom widths varying from 16 to 10 feet, about 2 miles of 6-foot bottom with canal and about 2 miles of 3-foot bottom width laterals. Driftwood Canal, near McCook.
Do	Constructing open drains and appurtenant structures near Sargent.
Do	Relocating and rewiring the starter and the control and power supply equipment for three 50-horsepower pump motors at the Franklin South Side Pumping Plant near Franklin.
MRB, Nebraska-Kansas.	Constructing 11 pump turnouts, 4 gravity turnouts, and one timber farm bridge on canals between Harlan County Dam and Lovewell, Kansas.
Do	Earthwork and structures for about 4.4 miles of drain, including corrugated metal pipe drainage inlets, sheet pile and riprap drops, and extending a precast concrete pipe siphon; and constructing a 30-inch precast concrete pipe wasteway on the Franklin Canal, near Red Cloud, Nebraska.
MRB, North Dakota.	Constructing footings and furnishing and erecting steel towers for about 160 miles of single-circuit, 230-kv transmission line. Work will include clearing right-of-way and furnishing and installing fence gates. From Fargo, North Dakota, to Granite Falls, Minnesota.
Do	Constructing additions to Fargo Substation will include constructing foundations, furnishing and erecting steel structures, and installing a 115/69-kv, 25,000-kva autotransformer and associated electrical equipment. Near Fargo.
Do	One 3-phase, 5,000-kva, 110- to 34.5-kv, class OA, outdoor power transformer with 3 low-voltage, station-type, tank-mounted lightning arresters. For the Watford City Substation.
MRB, South Dakota.	Installing tile drains and regrading Watertown Substation yard area. At Watertown.
Do	Constructing open and closed drains on the Angostura Unit, near Hot Springs.
Do	Constructing footings and furnishing and erecting steel towers for about 65 miles of single-circuit, 230-kv transmission line.
Do	Constructing additions to the Sioux Falls Substation will include grading and fencing an additional area, constructing concrete foundations, furnishing and erecting steel structures and installing one 230/115-kv, 100,000-kva autotransformer, 115-kv power circuit breaker and associated electrical equipment. Near Sioux Falls.

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The Reclamation Era

MAY 1957

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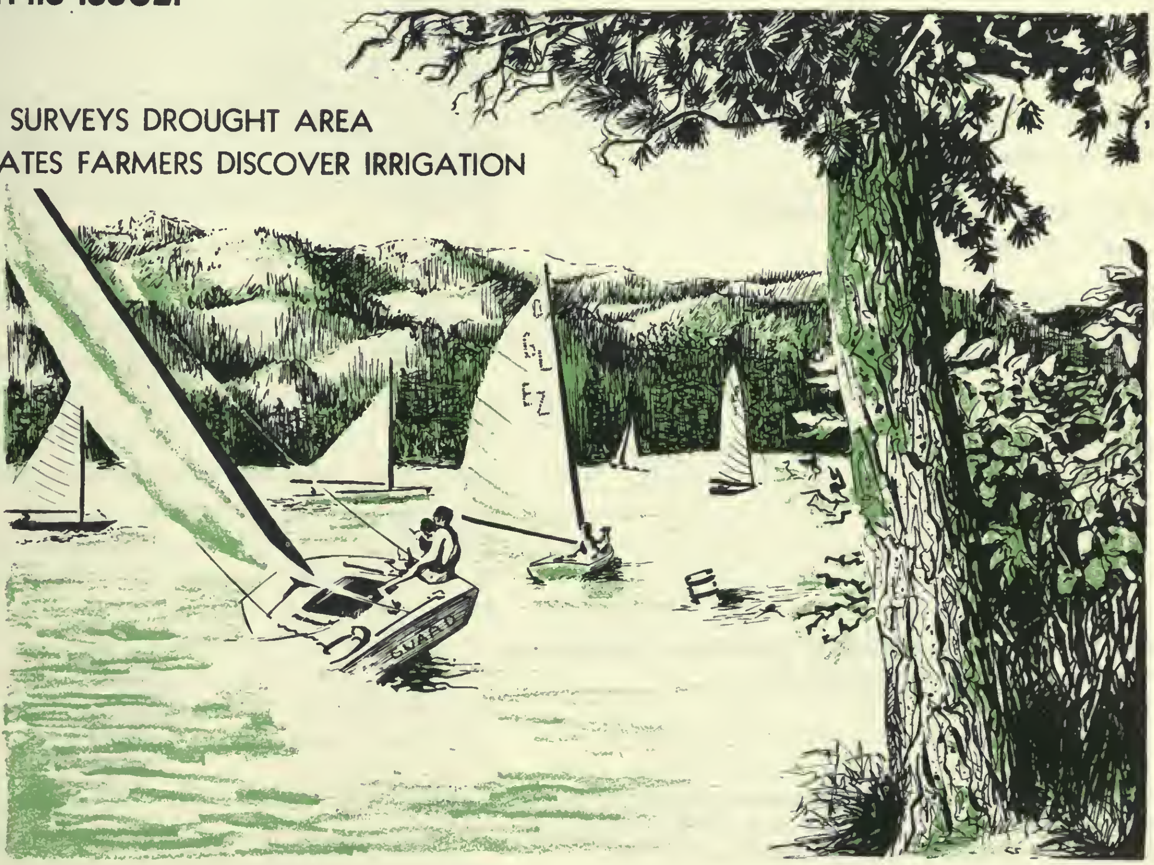
PRESIDENT SURVEYS DROUGHT AREA
HUMID STATES FARMERS DISCOVER IRRIGATION



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* * *

30 Years Ago in the Era

Let us develop the resources of our land,
Call forth its powers,
Promote all its great interests,
To see whether we also,
In our day and generation,
May not perform something to be remembered.

—*Daniel Webster.*

DESIGN AND ILLUSTRATIONS by Drafting and Graphics Branch
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J. J. McCARTHY, Editor

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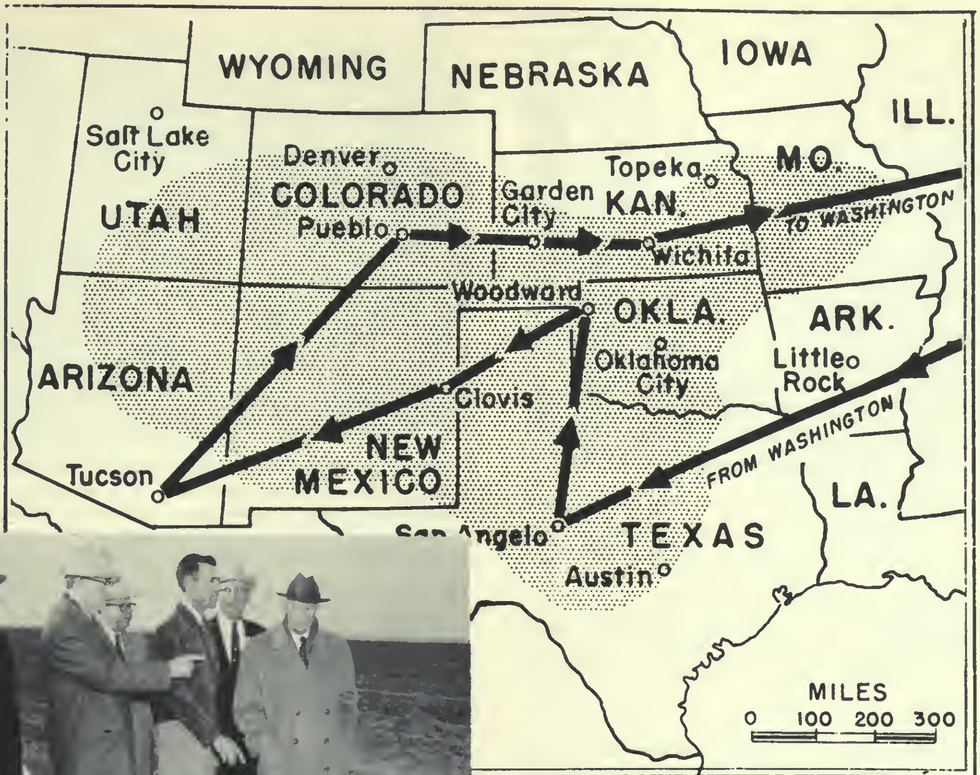

Left to right: Interior Secretary Fred A. Seaton, Agriculture Secretary Ezra Taft Benson, San Angelo County Agent Ed Hyman, Wilbur Block, Vice Chancellor D. W. Williams of Texas A&M College System, and President Dwight D. Eisenhower at Mr. Block's farm in San Angelo, Texas. *All Photos in this article by Abbie Rowe, National Capital Parks.*

President Surveys Drought Area

by OTTIS PETERSON

PRESIDENT EISENHOWER has injected renewed vigor into water resources development as the result of a personal "look-see" in the critical southwest drought area in January.

In his State of the Union message earlier in the month, the President said "*water is fast becoming our most valuable resource*" and then called for even greater comprehensive planning for the maximum multipurpose development of our river systems.

In the course of a flying trip to Texas, Oklahoma, New Mexico, Arizona, Colorado and Kansas, the President surveyed the immediate drought situation and emergency measures which are being taken to meet the crisis. But in concluding the trip at a Great Plains planning meeting at Wichita, Kansas, on January 15, the President included the following long range water and land management needs:

Editor's Note: Mr. Peterson, Assistant to the Commissioner, Information, toured the drought area in the accompanying press plane.

1. Develop further usage of our land and water resources, by range improvement and better management of watersheds.

2. Continue and expand research in better land and water use, in weather forecasting, in evaporation and transpiration reduction methods, and in saline water conversion. Further research and improvement in weather services to agriculture are needed. This includes monthly and seasonal forecasting that will better equip farmers and ranchers to adjust their operations to the climatic problems of these states.

3. Achieve maximum conservation and storage of surface and ground waters for agricultural, industrial and municipal purposes.

Going the whole route with the President were Secretary of the Interior Fred A. Seaton and Commissioner of Reclamation W. A. Dexheimer. They were called upon on several occasions to explain existing and potential water development projects which could assist in alleviating any drought situation.

PRESIDENT EISENHOWER at farm of Raymond Worrell, Clovis, N. M.

Left to right foreground: Carl Peoples, President Eisenhower, and Secretary Benson inspecting results of drouth at Mr. Peoples' farm, Woodward, Okla. Gentleman at left rear is unidentified.

Both Secretary Seaton and Commissioner Dexheimer made it plain that a reclamation project will not prevent drought but explained that the production from irrigated land is invaluable in times of drought by stabilizing the economy to a degree and particularly in providing feed for livestock herds.

The first stop, Sunday night, January 13, was at San Angelo, Texas. At a Monday morning breakfast, Harry Burleigh, head of the Bureau of Reclamation area investigations office at Austin, Texas, explained the proposed San Angelo project and the Gulf Basin investigations for the President and a group of about 25 people.

The President visited farms in the immediate vicinity of San Angelo, Texas; Woodward, Oklahoma; and Clovis, New Mexico, before stopping at Tucson, Arizona, for the second night of the tour, Monday, January 14. The following morning, during a stop at Pueblo, Colorado, he visited the ranch of E. A. Davis, traveling through territory which will be served by the Fryingpan-Arkansas Project.

Particularly striking was the contrast between irrigated lands on one side of the canal, where sugar beets had been harvested last fall, and sunbaked range land on the upland side which has been so dry for the last 3 years that cattle and sheep have been kept off of it. This has been necessary to save the little grass still on the range and prevent major erosion.

While the President was on his tour, a planning group was busy at Wichita on both emer-

Secretary Seaton and President Eisenhower at The Earl Byrd Ranch, San Angelo, Texas. These cattle were fed cottonseed pellets and prickly cactus burned by a flame thrower to make it edible.

PRESIDENT EISENHOWER getting FIRST HAND REPORT at the Earl Byrd ranch. With him (L. to R.) are Secretary Seaton, Vice Chancellor Williams, and County Agent Hyman.

gency and long range measures for drought alleviation. N. B. Bennett, Jr., Chief of Project Development, represented the Bureau of Reclamation on the subdivision particularly concerned with water utilization and conservation. Harold H. Christy of Pueblo, National Reclamation Association Director for Colorado, chairmanned this group.

A reexamination of storage space in existing reservoirs was urged by this group as a means of saving additional water through the drought years if the runoff permits. This was the principal immediate relief which the conference believed could be provided from water conservation projects. In the long range picture, the group looked to a pickup in investigation, authorization and construction of future projects and accelerated research programs in such vital fields as evaporation loss and saline and brackish water purification.

# # #

THE PRESIDENT meeting the Wilbur Block family and friends.

Cachuma's Recreation Record

View of concessionaire's boat dock, mooring area, tackle shop, and snack bar. *Photo by D. E. Creighton, Jr.*

In developing and managing the Cachuma reservoir area for recreational use Santa Barbara County, California, has pioneered procedures and methods which may provide useful guidance to other localities in which reservoirs are situated or proposed. The steps which the County took in reaching its decision to manage the area and the pattern which it has established for administration have been so successful that they merit recording as an example for others to consider.

Before reservoir construction started, when the Cachuma Project was still in the planning stage, a report on the recreational potential of the Cachuma reservoir area was prepared by the National Park Service. The preparation of such reports is customary procedure in Reclamation planning. The report of the Park Service showed that the recreational use would be high. It did not indicate whether recreational use should or should not be permitted since this is a matter of local and State regulation and policy. However, the advisability of such use was considered very carefully by the County Water Agency. The consensus of Agency representatives at a meeting in November 1947 was that boating and angling be permitted. Concerning administration of recreational use the National Park Service recommended that it be a County responsibility.

by EVERETT A. PESONEN

Conservationist

Bureau of Reclamation

Sacramento, California

The first step toward possible County management was taken on March 19, 1949, when the Board of Supervisors designated the County Planning Commission as the agency to coordinate matters pertaining to planning and development of the Cachuma reservoir area. The Board also directed that the Planning Commission call together as an advisory committee the representatives of local, State, and Federal agencies which had an interest in planning, protecting and administering the reservoir and its shorelands.

This committee was considered necessary because

the hillsides around the reservoir are highly inflammable during the fire season and subject to severe erosion if burned or over-grazed. Advice was needed particularly on the amount of land needed for fire and erosion control and, even more importantly, for adequate sanitary and pollution control. Serving on the Advisory Committee were representatives of the County fire protection, road and health departments, the U. S. Forest Service, Soil Conservation Service, National Park Service, State Division of Fish and Game, Division of Highways, Water Pollution Control Board, State Recreation Commission, and the Bureau of Reclamation.

As a first step toward determining the amount of land needed, a map was prepared showing a suggested acquisition boundary. This map was carefully reviewed by the advisory group and the suggested boundary inspected on the ground. With certain alterations it was recommended to the Planning Commission, and by the Commission through the Board of Supervisors to the Bureau of Reclamation. In addition, the advisers looked with favor on an emergency zoning ordinance, contemplated by the Planning Commission for control of private lands bordering the area suggested for acquisition. Subsequently, the recommended acquisition boundaries were accepted by Reclamation, and the contemplated zoning ordinance was adopted by the Board of Supervisors.

With the area for acquisition and control established, steps were taken next to prepare a public use plan for these lands. The Bureau of Reclamation again enlisted the aid of the National Park Service, this time to work with the County in preparing a master plan for recreational development. The master plan outlined the locations best suited to recreational use, together with a suggested system of roads, parking areas and utilities to serve the proposed uses and facilities, including camp grounds, picnic grounds, boat launching sites, etc. Suggested layouts for some of these facilities were also included.

The County authorities, realizing that they were breaking new ground, took particular care to keep the public informed of developments as each move was made. The press, aware that the moves being made by the county were significant, gave space generously to all meetings and to the plans which were formulated. The general layout plan for the reservoir area, for example, was published in a local newspaper and discussion on development of the area was featured in a citizens' conference

Continued on page 50

ABOVE: View of boat docking area, Cachuma Reservoir, looking easterly with Dock of Tri-Valley Yacht Club in foreground. ***Photo by D. E. Creighton, Jr.***

BELOW: Artist's conception of Cachuma Dam by *M. H. Willson, Bureau of Reclamation, Denver, Colo.*

Riverton's Alfalfa Seed Crop

Cattle on pasture—Dave Anderson lease—Cottonwood Bench Development Farm, 1956.

The Riverton Project, located in the Wind River Basin of west-central Wyoming, is becoming one of the important alfalfa seed producing areas of the United States. Like other irrigated areas of the West, the average seed yields are relatively high and dependable. The producing areas on the Riverton Project are new lands, having been brought into production since 1949. The areas are particularly adapted to the production of Foundation and registered seeds because they meet the isolation requirements.

The importance of alfalfa seed to the Riverton Project is best illustrated by the records of production. Average yields have varied from 100 pounds to over 400 pounds per acre, with some fields producing as high as 1,000 pounds per acre. Production of Certified seed on the Project in 1950 amounted to 268,454 pounds from 2,641 acres. In 1953, the total acreage increased to 5,923 acres and the production was 2,586,678 pounds. The production in 1955 was 2,326,975 pounds of cleaned blue-tagged certified seed from 6,990 acres. Production and acreage figures for the 1956 season are not available at this time; however, it is believed that there has been a slight increase in acreage and perhaps a yield of only 1,000,000 pounds. The causes for the reduced yield in 1956 have not been determined.

The varieties produced on the project are Buffalo, Ladak, Atlantic, Grimm, Vernal, Rhizoma and Narragansett. In 1956, nearly one-fourth of the acreage in the United States producing foundation legume seed under the National Foundation Seed Project was in Wyoming. Nearly all of this acreage was on the Riverton project.

The production of new varieties of alfalfa seed in the past have failed or have been seriously delayed because the early seed increases were used to plant meadows or pastures. The more recent program for increasing the seed production of new varieties follows a definite generation sequence, with the first one or two generations being used as stock seed for planting other seed-producing fields. Such a sequence is breeder, foundation, registered, and certified seeds. The breeder seed is that maintained by the originating station. Foundation seed is harvested from fields planted with breeder seed; registered seed is harvested from fields planted with foundation seed; and certified seed is from fields planted with registered or foundation seed. Foundation and registered seed are stock seed and are used to plant other seed fields. With some varieties, Vernal and Narragansett alfalfa for example, the registered seed class is omitted. The National Foundation Seed Project was organized to help supply these stocks.

The National Foundation Seed Project is a co-

by ROY C. VAN DREW,
Project Manager
Riverton, Wyoming

operative endeavor of approximately 37 State agricultural experiment stations; State certification agencies; the Forage and Range Section, Field Crop Research Branch, Agricultural Research Service; and the Commodity Credit Corporation. Its function is to place breeder seed of improved varieties with the better experienced seed growers in the cooperating States for the production of foundation seed. The various agencies cooperate closely in placing the breeder seed with the growers, supervising the production, and processing the foundation seed. The Commodity Credit Corporation contracts with the grower for the production of the foundation seed, finances the purchases and storage of the seed, and then distributes it through experiment stations and certification agencies to other seed producers. Mr. John G. Dean, Jr., of the Agricultural Research Service is in charge of the program of the National Foundation Seed Project. Mr. Charles M. Rincker, manager of the seed certification for the State of Wyoming, Dr. William A. Riedl, Wyoming Agricultural Experiment Station, the Fremont County Extension Service, the Fremont County Seed Growers Association, and the Bureau of Reclamation have been the cooperating agencies responsible for the interest and activity of the program on the Riverton project.

During the preliminary investigations made in 1954 by Mr. Dean, and Dr. Riedl for increasing the program of the National Foundation Seed Project on the Riverton project, it was found that several well qualified seed producers were available but these producers did not have land with the necessary isolation. Further investigation revealed that several hundred acres of unentered

Certified Narragansett alfalfa seed—Barrett lease—Cottonwood Bench, 1956.

lands on Cottonwood Bench under the control of the Bureau of Reclamation were suitable if they could be made available to the qualified producers. The Bureau of Reclamation welcomed the opportunity to cooperate with the other agencies in the seed production program and immediate steps were taken to negotiate leases with two qualified producers for lands to be used in the production of Narragansett and Vernal Foundation seed. One hundred thirty-eight acres of these varieties were planted with breeder seed in 1955. In 1956, additional areas totaling approximately 4,000 gross acres were leased to qualified producers. During the year, approximately 700 acres were seeded using breeder, foundation or registered seed. It is estimated that 1,500 additional acres will be placed in production during 1957.

It is interesting to note the importance of the seed producing areas in the irrigated section of the West to over-all grass and legume seed production and requirements of the United States. Approximately 80 percent of the grass and legume seed used in the United States is in the States of the Corn Belt, the Cotton Belt, and the hay and pasture regions. The average seed yields of crops such as alfalfa in these areas are low and uncertain, thus they are dependent upon the western States for most of the forage seeds that they plant. The annual seed requirements are approximately 200,000,000 pounds. Only approximately one-half or 100,000,000 pounds of these requirements can be supplied with certified seed at the present time.

Alfalfa seed production on the Riverton project certainly assumes a role of major importance.

Alfalfa seed—Barrett lease—Cottonwood Bench, 1956.

Shasta sets record

Shasta Dam, as a tourist attraction, chalked up an all-time record during 1956. Martin H. Blote, Regional Supervisor of Irrigation and Power in the Bureau of Reclamation's Sacramento office, stated that 296,168 visitors checked in at the dam. The U. S. Forest Service, which administers the recreational facilities of the reservoir behind the dam, estimates that 636,448 tourists and local people visited the lake during the past year. The number of registered visitors to the dam itself totaled almost 50 percent over 1955. The year 1946 set a previous high record for the number of visitors, with 278,575.

A scenic highway provides access to the dam and reservoir area and to view points. A vista house for the accommodation of visitors is maintained at the dam, along with parking areas. Conducted tours over the dam and into the interior of the structure are available for a small fee.

# # #

LARGE STREAMS of water like this often conducive to excessive waste through runoff. *Photo by Stan Rasmussen, Region 1.*

HOW TO CUT IRRIGATION WATER LOSSES

by CLIFF ASHBURN
Extension Farm Management Specialist, Scotts Bluff Experiment Station, Scottsbluff, Nebraska

How can we stretch the irrigation water to go farther on the local farm?

The best answer would be to take an inventory of the present irrigation system and see where water is being lost. There are four main factors for the losses of irrigation water on the local farm. It is estimated that 50 percent of the water turned in at the farm headgate is lost by the following factors.

1. Distribution losses.
2. Runoff or waste water at the lower end of the field.
3. Deep percolation.
4. Evaporation.

Distribution losses of water can be lowered by the use of a sprinkler system, by using gated pipe, by lining irrigation laterals, and by the use of underground pipe. Water losses are high when leaky pipe joints are used as well as other faulty equipment.

Gopher holes are another way water is lost. A good distribution system can save water, save labor and lead to more efficiency. The weed and erosion problems can also be held to a minimum where a good distribution system is maintained.

RUNOFF DOES NOT AID CROP

Runoff or waste water at the lower end of the field is not doing the crop much good. This is true whether gravity or a sprinkler system is being used. The method of spreading water should be designed for the soil type and slope. Where water is applied faster than the soil will take it, there will be runoff, erosion and a waste of water. The size of tubes used is very important. Some farmers are using two tubes and then cutting back to one after the water reaches the lower end of the field or next cross ditch. A sprinkler system should be designed according to slope and intake rate of the soil.

EXCESS WATER caused by poor drainage. *Photo by Stan Rasmussen, Region 1.*

LABOR SAVING irrigation tubes in use can be seen in foreground. *Photo by Norton F. Novitt, Region 7.*

Bench leveling or fields leveled to Soil Conservation Service specifications will also aid in controlling runoff and other methods of saving water. Where fields are quite level, some are plowing a furrow at the lower end that helps control runoff or waste water.

It is very easy to waste water on a light sandy soil because of deep percolation. This not only causes a waste of water, but also contributes to the loss of plant nutrients. The basic intake rate of a light sandy soil will be from 5 to 6 gallons of water per 100 feet of row. The first time over or until water reaches the lower end of the field a larger stream may be needed and then cut back. Because of the high intake rates, it is hard to push water very far down the row.

CHECKING PENETRATION of irrigation by gated pipe. *Photo by L. C. Axthlem.*

IRRIGATE SHORTER ROWS

The deep percolation loss on sandy land can be minimized by irrigating shorter rows and using tubes according to the slope, head of water and length of run. A soil auger is a good tool for measuring the depth that the water has penetrated. Deep percolation below the root zone of the plant is a waste of water. More frequent irrigations would help eliminate deep percolation losses on sandy soils.

Irrigation water is lost by evaporation, but this is hard to control as exposed water will evaporate. Again, underground systems and gated pipe will give some help in lowering the loss by evaporation.

Some research work in western States is being done to lower evaporation losses in stored reservoirs. Chemicals are being used on the surface of the water to lower the evaporation losses, but this could create other problems.

A good distribution system, controlling runoff or waste water, eliminating deep percolation and controlling evaporation will make more water available for the crops on our local farms. Taking an inventory of the irrigation system can help make the system more efficient and save water.

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WILLIAM R. WALLACE DEAD

The passing of William R. Wallace on January 29 takes from the scene another of those great men of vision who pioneered the development of our water resources. (See *Reclamation Era*, March 1953.)

He not only had the foresight to realize the importance of water in the future of the West but he also possessed the determination necessary to convince his fellow westerners, the Congress and the Nation.

He sacrificed his time, effort and personal gain to further the development of the West and its water and land.

When Reclamation was threatened, he took a personal hand to see that water resources development kept rolling. On occasion, when investigative funds for a particularly important project ran out, he dug into his own pocket to finance them.

Not only Utah but all the West will long remember with gratitude "Uncle Billy's" outstanding leadership in Reclamation. He will be missed as a great leader and personal friend.

Water Report

OUTLOOK FOR 1957 WATER SUPPLY OF THE WEST

by HOMER J. STOCKWELL
Snow Survey Supervisor, Soil Conservation Service
Fort Collins, Colorado
and
NORMAN S. HALL
Snow Survey Leader, Soil Conservation Service
Reno, Nev.

PALISADES PROJECT RESERVOIR. Looking upstream from below Elk Creek. *Photo by Phil Merritt, Region 1.*

Except in a few isolated areas of western United States, 1957 streamflow from snowmelt will be less than it was last year.

No extremely heavy snow pack was measured in the Pacific Northwest mountains this April 1 as contrasted to extremely heavy snow packs found there a year ago. Water supplies for irrigation and power over the states of Montana, Idaho, Oregon and Washington are expected to be reasonably adequate to meet demands.

In the extreme drouth areas of the southwest there generally has been some improvement over a year ago, but the shortage of water is definitely serious. Prospective supplies for parts of Colorado, Utah and California will be deficient. Severe shortages, comparable to the past two years or more, are in prospect for New Mexico and Arizona. Streamflow will be below average for most areas in California. Late season shortages may be expected where carryover storage is not adequate.

In view of the seasonal outlook over the West, good water management practices are a must again this year. It is important to note that in many areas of the West a water supply even better than average is no longer sufficient to meet the increasing demands. If maximum benefits are to be obtained from the use of water, there must be an increased concern on the part of each user to see that the available water is used effiicently.

Forecasts of 1957 irrigation water supplies in the West are based on April 1 measurements by the U. S. Department of Agriculture, Soil Conservation Service and many other[1] organizations on about 1,300 snow courses. Water content of the snow, soil moisture conditions under the snow as well as in irrigated areas, and the amount of carryover storage in nearly 200 reservoirs are considered in appraising the supply outlook.

Although runoff will be about average in the Pacific Northwest, only isolated areas will experience water shortages. Water supplies will exceed the usual demands along the main streams in Montana, Idaho, Washington and Oregon. As usual, some shortages are expected on smaller tributaries without adequate storage. Because of heavy streamflow last year, and the resulting carryover, storage in irrigation reservoirs is above normal. Mountain soils are wet and soils in irrigated areas are in fair to good condition as far as moisture is concerned. This favorable outlook extends from the Northwest to northern and cen-

[1] The Soil Conservation Service coordinates snow surveys conducted by its staff and many cooperators, including the Bureau of Reclamation, Forest Service, Geological Survey, other Federal Bureaus, various departments of the several states, irrigation districts, power companies, and others. The California State Department of Water Resources, which conducts snow surveys in that state, contributed the California figures appearing in this article. The Water Rights Branch, British Columbia Department of Lands and Forests has charge of the snow surveys in that province and likewise contributed the information here for British Columbia.

tral Utah and the Colorado river drainage of western Wyoming and Colorado.

Mild water shortages may occur on Wyoming and Colorado streams, east of the Continental Divide. Winter snow pack has been much above normal, but years of drouth have reduced the amount of water to be expected from a generous snow pack. Unless summer rainfall is above normal, rather severe shortages of water will be experienced on the lower reaches of the South Platte in Colorado and the Arkansas in Colorado and Kansas. Soil moisture conditions, particularly near the mountains, were improved by major early April storms on the plains.

The outlook for the Rio Grande in New Mexico is substantially improved over 1956 but continued water shortages will be experienced, especially in New Mexico. In Arizona, the water supply is again critical, similar to the past several years. Water demands far outstrip surface supply. Less reservoir storage is available than for any recent year. No surface water is available from San Carlos reservoir on the Gila river. It's dry! Extensive use of ground water to supplement surface water for irrigation will be needed in New Mexico and Arizona. The prospective lack of streamflow extends to southern parts of Utah and Nevada.

Streamflow in California and Nevada will be below normal. In California's Central Valley surface water may become critically short in late season on streams which do not have carryover storage. Shortage may also be expected for coastal areas and southern California. Considerable dependence will be placed on importations. In Nevada, irrigation season water supplies will be normal in Paradise Valley, north of Winnemucca, and fair to poor in other areas depending on storage rights.

Forecasts for the major streams of the West for the April-September 1957 period as compared to normal, include:

Columbia River at The Dalles—104,000,000 acre feet or 107 percent

Missouri River at Toston—2,040,000 acre feet or 80 percent

Colorado River at Grand Canyon—10,100,000 acres feet or 100 percent

Rio Grande at Otowi Bridge—700,000 acre feet or 82 percent

Sacramento River inflow to Shasta Reservoir—1,650,000 acre feet or 89 percent

San Joaquin below Friant—750,000 acre feet or 59 percent

The accompanying chart showing the status of reservoir storage, and a map indicating the approximate runoff forecast for each area, summarize the 1957 water supply outlook for the West. In the following paragraphs the water supply outlook by states is briefly reviewed:

ARIZONA The shortage of water continues. Last fall was dry with reservoir storage critically low. Heavy precipitation in January was followed by warm weather which induced early snowmelt and a good yield of water was obtained. The flow of the Tonto river will be above average for the season, but the overall yield of the Salt and Verde river systems is expected to be about three-quarters of normal. The January storms were not effective on the Gila and San Francisco watersheds.

Total water available on the Salt and Verde rivers will be enough to forestall any serious cutback of water for the Salt River Valley users. They will again have to draw heavily on underground water, further lowering the water table. Unless heavy rains occur, water in storage this fall will be very low.

No surface water from snowmelt runoff will be available to users below San Carlos reservoir.

BRITISH COLUMBIA April 1 snow course readings reveal normal runoff for the southern mainland Coast, Kootenay, Columbia, and Fraser watersheds of British Columbia. Below normal water supplies are anticipated for the southern Okanagan, Similkameen, Skagit, and Vancouver Island basins. Light snow cover is general in these areas.

In the lower elevations of central and southern interiors, day-time heating for March reduced the snow pack considerably. At higher elevations little of the winter's snow has melted.

CALIFORNIA The Department of Water Resources reports the water supply conditions as of April 1, 1957, are below average in all of the state except the extreme northern portion of Sacramento river. Seasonal precipitation is generally below normal even with February and March precipitation above normal in the north.

Snow pack in the Cascade and Sierra Nevada mountains still is significantly below April 1 expectancy. Effective snow line elevation varies from 5,000 feet on the Yuba to 8,000 feet on the Kern river. During the first six months of the 1956–57 water year, runoff was below average in most areas of the state. However, in northern areas, near or above average runoff occurred during February and March in most major rivers. Water stored on April 1 in California reservoirs is 60 percent of capacity, or 115 percent of average for April 1. Carryover from the previous water year is responsible for high storage.

Water supply forecasts prepared by the Department of Water Resources show snowmelt runoff for Cascade and Sierra Nevada mountains considerably below average. It varies from 33 percent on the Tule river in the south to 89 percent on the Sacramento river in the north. Late season water shortages may occur where carryover storage is inadequate.

COLORADO Snowfall is above normal in the mountains and water supplies should be adequate for most areas of the western slope. Limited shortages are expected on the South Platte, Arkansas and Rio Grande with rather severe shortages in the lower reaches of the Platte and Arkansas rivers. Reservoir storage is low, but with spring rainfall some opportunity will be provided for partial replacement. The outlook is the best since 1952, but shortages will occur in he heavier demand areas. Soil moisture conditions are good on the irrigated areas of the

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Humid States Farmers Discover Irrigation

by

W. J. LIDDELL, Vice President

Dixie Irrigation Company, Memphis, Tennessee

"Man, I've spent a lifetime draining this country and I'm certainly not going to help put water back on it." Such was the remark of a farm machinery dealer in the delta county of northeast Arkansas when asked to sell irrigation equipment.

His friends and customers do not share his belief, however. They had helped to drain land, too. Then they found that every year crop yields were hurt because of drouth. It might be of short duration or maybe it would be a long one. In any event it meant less money would be theirs in the fall; less money to repay the crop loan at the bank, less to pay the hands, less to spend for clothes, appliances, new cars, and machinery.

Irrigation came early to some places in the east. From irrigating rice fields it was just a step to watering cotton and pasture in Arkansas and Louisiana. Irrigation of vegetables in Florida and New Jersey was the only answer in preventing ruinous losses from frequent, irregular drouths.

All over the east many a crop has burned up from lack of moisture, and yet along side the field flowed a fine stream of water. It wasn't that the farmers were unmindful of the possibilities of irrigation. They weren't. But the job seemed too great. That is, until sprinkler irrigation came along with its lightweight portable pipe and pumps.

Investigating the cost of the new systems, many growers found it possible to more than repay the cost of the equipment from increased yields of a single crop. On lower value crops more than one year is generally required for the recovery of the investment. Since the life of the equipment is 15 years or longer and maintenance costs are quite low, a rapid return is not compulsory for the investment to be economically profitable.

The Citizens and Southern Bank in Georgia 2 years ago made a careful study of its 6-year experience record in financing irrigation loans. So impressed were the officials with the repayment records and profits made by irrigation farmers, that they drastically expanded their already excellent program in financing irrigation. Their policy of helping the Georgia farmer to help himself has not only continued to benefit farmers, but also the communities, and the State as a whole, not to mention the bank itself.

Under the Federal Housing Administration program of the U. S. Department of Agriculture loans have been completed in the last two years for the installation of irrigation on 120,000 acres in 31 eastern States. Insurance companies, commercial credit companies and other lending agencies are continuing to enter and expand their participation in the irrigation finance field. The Agricultural Conservation Program in most States encourages farmers to develop their irrigation potential by making allowances for pond development, land leveling and soil improvement practices.

Irrigation research in the East has increased from a handful of minor projects before World War II to multiple projects in every State. A continuing survey of these projects and their results

has been undertaken by the Sprinkler Irrigation Research Committee of the American Society of Agricultural Engineers under the direction of Chairman E. H. Kidder. This information is available to anyone interested.

The Agricultural Research Service program of the U. S. Department of Agriculture in irrigation research includes around 25 separate phases of investigation. Federal-grant funds have enabled every State Experiment Station to add timely and worthwhile projects for studying and developing irrigation practices and methods.

One of the early Federal-State projects was started in 1945 in Georgia. The useful information given out by projects such as this is exemplified in a recent report by John R. Carreker, project supervisor. From 5 years of irrigation studies 1952–1956, it is indicated that the optimum moisture requirements of cotton are 16 inches during the 90-day growing period from May 28 to August 27. Greater or lesser amounts reduced yields.

About 3 inches of moisture can be obtained from the soil. The balance, averaging 4.3 inches per month, must be furnished by rainfall or irrigation. The grower must see to it that his cotton has available its daily quota of .20″ of moisture if it is to make top yields. Irrigation produced yields of 3,257 to 3,621 pounds of seed cotton, while on unirrigated plots yields were 1,952 pounds of seed cotton per acre. During this period rainfall and soil moisture supplied 11.15 inches to the crop.

At Lewisburg, Tennessee, the Dairy Experiment Station reports an average increase of $99 per acre in terms of milk production over and above the

Above: Nelson Brown, Clarksville, Tennessee over 2,200 pounds per acre on his burley for be moved while main is under pressure b McUmber shows visitor operation of his valve to pump and shutting off pressure. Below ri tion plans beside one of their three 14″ courtesy of the author.

types of irrigated tobacco. He has averaged
Below left: Sprinkler lateral in this orchard can
lved mechanism in foreground. Below: R. R.
he can shut off and move lateral without going
Umber and Alonzo Womble discuss their irriga-
enfield, Tennessee. *All photos in this article*

cost of pasture irrigation from 1951–1954. A survey of Kentucky tobacco growers showed increases due to irrigation averaged over $350 per acre.

Producers of shade tobacco grown for cigar wrappers in Connecticut and north Florida all say the same thing—they wouldn't plant their expensive crop without having their irrigation systems ready to go into action. They haven't failed to use them as some time during the season in any year since they have first started irrigating.

Over 130 different crops are irrigated in the East. Portable sprinkler systems are used on more than 80 percent of the farms. About 10 percent use permanent overhead sprinkler systems, about 5 percent use ditches, 2 percent gated pipe, and less than 5 percent use flooding. Sprinklers are the most popular method of application because of the rolling topography, limited soil depths or water supplies, small degree of skill required to operate, and the excellent control afforded. However, in areas where land forming is being done and in other places where it can be used, gated pipe is mushrooming in popularity.

Self-propelled and mechanical move systems are beginning to interest the eastern irrigator. His dislike for the muscle-power requirements of hand-moving pipe over large acreages has caused him to study the possibilities of rearranging his small, cut-up fields and to raise the extra investment capital needed for the mechanical systems. Labor-saving devices, methods, and equipment continue to be the number one concern of farmers, industry and researchers alike.

The tremendous task of educating would-be

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Nelson Brown stands in alley cut out for his irrigation pipe. Loading pipe off and on a trailer proves to be the easiest way to move.

technicians, interested farmers, and new irrigators has been accomplished with particular credit due a number of agencies. The Agricultural Extension Services schedule meetings each year on a country-wide and sometimes on a State-wide basis. Colleges have added courses in irrigation to their agricultural and engineering curricular; they have held many short courses in irrigation open to the public.

To irrigation industry itself is due no small amount of credit. In addition to numerous meetings for farmers and dealers held by individual firms, the Sprinkler Irrigation Association through its Educational Director, develops a program of irrigation clinics in various States in cooperation with local representatives of the Soil Conservation Service, the Extension Service, FHA, colleges, vocational agricultural teachers, bankers, businessmen and farm leaders. To date, more than 20 clinics have been held to instruct farmers, irrigation dealers, and technicians in the best known practices in dealing with their irrigation problems.

Every kind and type of irrigation has been practiced somewhere in the East. While there have been many stories of success, there have been a few failures. Much more research and education is needed. Obviously crops of high value can be made to pay off under irrigation in spite of blunders, mistakes, and poor management.

Lower value crops, such as beef pastures, require skilled management to make profitable returns from irrigation. The University of Illinois pointed this out from their 6 years of experiments. The returns from using irrigation hardly paid for their labor and operating costs, to say nothing of interest, taxes, depreciation, and amortization of investment. Irrigation in itself never makes a good farmer out of a poor one; but it can help a good farmer do a better job. Because lots of good farmers in the humid States are finding this out, irrigation is rapidly becoming a standard practice in their farm program. ###

IDEAS WANTED

Have you a good idea on a short cut or labor-saving device to share with other water users on Reclamation projects? Send it in to the Editor, *Reclamation Era*, Bureau of Reclamation, Washington 25, D. C. The writing does not have to be fancy. Just make certain you have the answers to Who, What, Where, When, Why, and How in your story. As for pictures, a rough sketch or snapshot would serve the purposes. Remember, this is the only official publication of the Bureau of Reclamation, the only periodical devoted entirely to the interests of water users on projects served with facilities made available by the Bureau. It is your magazine, and will be as good as you can make it. By helping others you will also help yourself. Send your item in today.

Spuds? Eat 'em Jacket and all, Says Stanek

The best-dressed potatoes, nutritionally, wear their jackets to dinner! May Stanek, Colorado A and M College extension nutritionist, says that jacket cookery for both boiled and baked potatoes saves the most in food value—saves time in preparation. Of the two methods, she says, boiling conserves more vitamins than baking.

Even though weight watchers often scorn potatoes, Miss Stanek says one medium-sized potato has no more calories than an apple or banana. It's the gravy, butter and other fats that, used in large amounts, really pile up the calories.

Although the potato is a good and inexpensive source of energy, Miss Stanek adds that by eating potatoes daily you can get as much as one-fourth of your vitamin C quota, plus some B vitamins, iron and other minerals.

When preparing hash-browns, use potatoes that have been chilled thoroughly in the refrigerator. They will absorb less cooking fat, Miss Stanek points out.

Reprinted from Colorado A&M News

View of Lowland site on Prairie near Cedar Bluff Reservoir in Kansas. *Photo courtesy of author.*

Improving Our Grasslands

by DR. GERALD W. TOMANEK
Professor of Biology
Fort Hays Kansas State College
Hayes, Kansas

Our grasslands are a heritage which we should appreciate and understand. An area of 320 acres of native grassland near Cedar Bluff Reservoir in Kansas was leased by the Bureau of Reclamation to Fort Hays Kansas State College for preservation and study. For many years this area has been very lightly grazed and for the past few years it has been unused. Areas of this nature, which are in climax or near climax condition, are used by Government technicians and ranchers in classifying the range conditions of grazed pastures. These areas are used as a control, and the degree of degeneration that is found in grazed pastures is used as a criterion for classifying them. Climax areas are becoming very rare in the Great Plains. There is a definite need to preserve some of these areas in various localities so that Government technicians and ranchers will have some type of measuring stick to determine the range condition of grazed pastures. Other values derived from the preservation of grassland areas such as the one at Cedar Bluff are their esthetic value and their use for research projects. Grasslands are beautiful and they should be protected so that generations of the future might know what they were before being wrecked by the plow or overgrazing. Since areas of this type are rare, it is quite important that research data be collected and published on the climax plants and animals that inhabit them. Many practical applications of data of this nature are possible even though they are not always apparent.

This grassland area of 320 acres can be divided into three general sites: uplands, breaks, and lowlands. The uplands are located on the high ground and are generally quite level. The soil is deep and mature. Principal grasses on this site are the short grasses, buffalo and blue grama.

Other taller grasses such as western wheatgrass, side-oats grama, and big bluestem are found growing in buffalo wallows and other depressions. Three-awn grasses and squirreltail are scattered through the short grasses. The breaks are located on the slopes and are characterized by a shallow soil underlaid with fragmented rocks but have soil in the crevices. The two principal grasses on this site are blue grama and side-oats grama. A greater percentage of taller grasses is found here, such as big bluestem, little bluestem, and switch grass. This site also supports a large population of broad-leafed plants whose flowers add a great deal of color to the landscape. The lowland is the best watered site of all since it catches all the run-off from the other two. Hence it supports a lush growth of taller grasses such as big blustem, switch grass, western wheatgrass and tall dropseed.

Over twenty research projects have been started on this prairie, but space will not permit description of all of them. However, a few can be listed and one or two explained in detail to illustrate the nature of the information that *can* be obtained. Some of the things being studied are forage yields of different sites, a description of the natural plant and animal communities, effects of mulch on growth of vegetation, effects of inundation on shoreline vegetation, chemical composition of important plants, continuous record of soil moisture, effects of grazing on composition, long-term changes in vegetation in relation to climate, effects of dusting, natural succession of plants and animals on disturbed areas, effects of native animals on plants, population studies of native animals,

View of Break site on Prairie near Cedar Bluff Reservoir, Kansas. ***Photo courtesy of author.***

and many more. The long-term lease will make some of these studies very valuable because continuous records can be collected over a period of nearly 50 years.

One of these studies that might help illustrate the importance of researches of this nature is the effect of grazing on composition. The conditioning of a native pasture is determined by the composition of the vegetation or, in other words, the percentage of total vegetation made up by different species. The climax vegetation is used as a control. If a native species decreases in abundance as a result of grazing, it often is called a decreaser; if it increases, an increaser; if it was not part of the climax and comes in as a result of grazing, it is an invader. The vegetation on this undisturbed prairie was compared to that of neighboring prairies which had been subjected to different intensities of grazing. The changes in composition of the principal species are shown in table 1.

Table 1. *Composition changes (percent) of principal species on different sites as a result of grazing. Ng—nongrazed, Mg—moderately grazed, Hg—heavily grazed*

Grasses	Uplands			Breaks			Lowlands		
	Ng	Mg	Hg	Ng	Mg	Hg	Ng	Mg	Hg
Buffalo grass	51	76	89	13	25	45	2	5	32
Blue and hairy grama	42	22	11	42	38	38	5	6	12
Side-oats grama	1	0	0	34	32	14	6	29	29
Western wheatgrass	2	0	0	0	0	0	5	12	10
Big bluestem	2	0	0	8	2	0	60	38	9
Little bluestem	0	0	0	5	2	0	0	0	0
Switch grass	0	0	0	0	0	0	17	8	3

Continued on page 51

Field Sanitation Through WEED CONTROL

by **FRANK M. FEFFER, President Arizona Fertilizers, Inc. Phoenix, Arizona**

Probably one of the most neglected and yet one of the most important phases of any farming operation is field sanitation. By sanitation we mean the cleaning of fence rows and ditchbanks of weeds, and the prompt plowing or discing of harvested fields to prevent weeds and unwanted crops from going to seed and thus preventing a weed problem in the subsequent crop.

It sounds as if we were talking about weed control—we are—but field sanitation goes much further than that. Weed control or field sanitation not only kills the unwanted plants that rob the soil of nutrients and our most precious resource, water, but also is a great aid in controlling harmful insects and diseases.

A list of some of our most common Arizona weeds and the insects for which they serve as hosts is as follows:

Weeds	*Insect Pests*
Bullhead	Aphid, cowpea; Spider mite, desert
Cantaloupe, volunteer	Aphid, cotton or melon
Carelessweed	Aphid, cowpea; Armyworms, beet and yellow-striped; Leafhopper, small green (empoasca)
Cressa	Spider mite, desert
Globemallow (sphaeralcea)	Aphid, green peach; Whitefly of cotton
Helistrope, wild	Lygus
Horsenettle (blueweed)	Aphid, green peach; Thrips of cotton; Whitefly of cotton

Weeds	*Insect Pests*
Jackass-clover	Cabbageworm, southern.
Jimpsonweed (datura)	Aphid, green peach; Borer, potato stem
Johnsongrass	Aphids, corn leaf and rusty plum; Borer, lesser cornstalk
Knotweed (polygonum)	Aphid, cowpea
Lambsquarter (goosefoot)	Aphids, cowpea and green peach; Leafhopper, beet
Malva	Aphid, green peach; Whitefly of cotton
Mustard, wild	Aphids, cabbage and turnip; Caterpillar, diamond-back moth; Chinch bug, false
Nightshade	Aphid, green peach; Leafhopper, beet; Whitefly of cotton
Ragweed (ambrosia)	Whitefly of cotton
Russianthistle	Aphids, cowpea and green peach; Leafhopper, beet
Tidestromia	Fleahopper, cotton

Many of our insect pests of economic importance in Arizona are included in this table. The list could include more weeds and more insects, but those weeds and insects indicated do several million dollars worth of damage each year.

Most of the virus disease of our crop plants are insect borne from weed hosts that act as virus reservoirs and help to perpetuate diseases. For example, there are many strains of mosaic viruses which infect potatoes that are usually transmitted either from weed hosts of the virus or from diseased potatoes to healthy potatoes. Lettuce moasic is aphid spread and several weeds are not only suspected to be reservoirs of the disease but serve as hosts of the disease-spreading aphids.

There are many insect pests that feed and breed on weeds and migrate from them to crops that become serious pests. One of the prime examples is the lesser cornstalk borer. Johnsongrass is one of its favorite weed hosts. There is hardly a grain sorghum grower in Arizona that did not experience at least some trouble from this pest during the 1956 season. Many thousands of acres of hegari and maize were replanted because of the widespread infestation of the lesser cornstalk borer. Field sanitation would have at least been helpful in alleviating this serious situation.

But the main economic loss due to weeds is not by being hosts to insect pests and diseases. Just the presence of weeds in and around our fields actually causes more economic loss by several million dollars than do insects and diseases combined. Weeds are the most expensive crop the farmer grows, or tries to grow. They rob his soil of nutrients and water; they compete with his crop plants for light and growing room. They also cost him for the hoeing, the cultivating, the burning, and the chemical control dollars he spends in trying to kill them and many times control is wasted or inadequate.

Weed control is sadly overlooked by many farmers. Ditchbanks and fence rows are often neglected until someone has some free time to chop and spray; rather than doing this important job as a regular farm chore. Much of the cultivating and hoeing in fields would not have to be done if fence rows and ditchbanks were kept clean, because it is in the fence rows and ditches that most of the weed problems start. Look at a field sometime and notice where most of the weeds are. You will find them usually along the margins, particularly next to fence rows and ditches, or ask a farmer why he has a strip of Johnsongrass through his field. He will usually answer that a ditch used to be there.

With modern methods of weed control, there is no excuse for growing such an expensive crop as weeds that can only be harvested at a loss. Adequate field sanitation can make money without planting a crop or adding an acre. A large quantity of the water that really should be available for crop consumption is being stolen by our enemies, the local weeds. ###

ALFALFA SLIDE SET FOR LOAN

A slide set—Successful Alfalfa—You Can Grow It—has been assembled in cooperation with many of our college agronomists. This is composed of 40 slides in color and is accompanied by a suggested script. The set is built around "10 steps to successful alfalfa production." While it tells a rather complete story it is designed to supplement local slides.

This set is available on loan for 10 days from:
American Potash Institute
Midwest Office
Life Building
Lafayette, Indiana

When writing for it please indicate when needed. Sets will also be sold at cost—$8.00.

SIGNS OF THE TIMES

Sign on a highway near Superior, Nebraska, city limits: "Fine of $1 for every mile in excess of 25 miles per hour. Pick out the speed you can afford." *Reprinted from Bureau of Reclamation "Safety Record"*

WATER REPORT

Continued from page 36

western slope. As a result of heavy April snows, soil moisture conditions on the east slope are fair to good.

IDAHO Seasonal snow pack in the Idaho mountains varies from slightly above normal in the north to a little less than normal in the south. The main stem of the Snake river is above normal with excellent carryover storage. There will be greater use of this storage because of the additional supply in the new Palisades reservoirs. The Kootenai river has the first near normal snow pack for several years. April storms could raise the streamflow considerably above normal.

Southern tributaries of the Snake river have had excellent winter flows. The water supply outlook is good where there is storage but late season shortages may occur where there is none.

Due to February rains, soil moisture conditions are above normal at high and low elevations. The mountain watershed soils are primed to yield maximum runoff.

KANSAS Water supply outlook along the Arkansas river in western Kansas is poor. There is practically no storage in John Martin reservoir and prospects for storage from snowmelt runoff are negligible. Soil moisture conditions are poor even with high precipitation in recent weeks.

MONTANA The April 1 water supply outlook in the Missouri basin is generally good and slightly better than reported on March 1. In the Yellowstone basin the outlook is close to normal at the headwaters, but dwindles to about 86 percent of normal at Sidney. The Columbia basin outlook in Montana is generally good on the Flathead but only fair along the Clark Fork to the junction of the Flathead. Recent storms have not materially improved the water supply outlook.

Irrigation reservoir storage is 98 percent of normal and all reservoirs should fill with the spring runoff.

NEBRASKA Unless summer rainfall is normal or above there may be some water shortages in western Nebraska. The inflow to the major reservoirs in the North Platte in Wyoming is expected to be above normal but carryover storage for the older North Platte area is limited. As of April 1 soil moisture in irrigated areas is deficient. Water supply outlook is similar to that of last year. Storage on Kansas river tributaries is adequate for present irrigation requirements.

NEVADA Runoff on the Owyhee river and Humboldt river ranges from 75 to 87 percent of normal. Eastern Nevada snow pack measured 65 percent of normal while the southern part reported at 40 percent of normal.

Streams flowing into Nevada from the California Sierra mountains will flow from 85 percent on the Little Truckee to 75 percent at Lake Tahoe. Moving south, the Carson river watershed is being forecast at 70 to 80 percent and the Walker river watershed 50 to 70 percent.

In general, all users of reservoired water can expect adequate supplies. Irrigators depending on natural flow will experience late season shortages.

NEW MEXICO The flow of the Rio Grande through New Mexico will be more than for any year since 1952. Inflow to the Middle Rio Grande Valley will be about 75 percent of normal, and to Elephant Butte about 50 percent.

Continued severe shortage of surface water is almost certain for the Middle Rio Grande and southern New Mexico area. Use of groundwater will again be necessary at about the same rate. Storage is less than 10 percent of normal on the New Mexico section of the Rio Grande. The water supply outlook for the Carlsbad and Tucumcari projects is poor, principally due to lack of reservoir storage and drouth in irrigated areas.

OKLAHOMA Irrigation water prospects on the Lugert-Altus Irrigation District are poor. There is no inflow to Altus reservoir. Soil moisture conditions are good but the 9,500 acre feet stored in the reservoir as of April 1 will supply only a small fraction of normal water demands.

Aerial view of ANCHOR DAM site—Owl Creek Unit of the Missouri River Basin Project in Wyoming

OREGON Deficient irrigation water supplies are anticipated only in portions of the Crooked river basin and in some of the small watersheds which head below the mountain snow zone. Most irrigation reservoirs are filled or can be filled in the next few weeks. Mountain and valley soils are wet. Water content of snow increased more than normal during March. Mountain soils are not frozen.

Over two-thirds of Oregon's twenty large irrigation reservoirs are filled to capacity. None are less than 85 percent except McKay which is 70 percent of capacity. Storage in these reservoirs is 134 percent of the 1938–52 average.

And adequate supply of irrigation water is foreseen for much of Oregon. Important irrigated areas for which poor to fair water supplies are foreseen this season are as follows: Burnt river above Unity reservoir; Grande Ronde above LaGrande; McKay, Birch, Butter, and Willow Creeks in Umatilla and Morrow counties; Crooked river basin except for Ochoco creek; Cow creek on the South Umpqua; Applegate and Illinois rivers in Rogue basin and many low-elevation tributaries of the Rogue; Silver Lake, Chewaucan, and Warner Lake basins; and the Silvies river area.

SOUTH DAKOTA Less than normal streamflow will occur from snowmelt. Reservoir storage is about one-half that of a year ago. Some shortage in the Black Hills area must be expected.

TEXAS The irrigated area of West Texas along the Rio Grande will experience a continued severe shortage of water. Low storage in Elephant Butte and about one-half normal inflow will again limit water supplies to about one-third of normal. The outlook for the irrigated area below Red Bluff reservoir on the Pecos is poor. Storage is only about 15 percent of that of a year ago.

UTAH Water supplies for practically all areas in the central and northern part of the state are expected to be good. A few watersheds may yield 5 to 10 percent less than average, but the supply should still be adequate. Seriously short supplies are still expected in the southwest for users served by the Sevier and Virgin rivers and the smaller streams originating in the same area. Although supplies for users served by the main Sevier river are expected to be poor, they will be fair to good for those served by the smaller tributaries below Piute reservoir. In the Uintah basin the upply outlook is good in the west but only fair in the east. Late season shortages can be expected on Ashley and Brush Creeks, and the Uintah and Whiterocks rivers.

WASHINGTON Streamflow from snow packs will vary from 88 to 108 percent of normal. Irrigation reservoirs contain about 10 percent more than last year. Mountain soils are wet. Streamflow will be much less than a year ago, but the total supply will meet all irrigation demands. Storage in power reservoirs is generally less than normal but these reservoirs will fill during snowmelt.

WYOMING Except for the main stem of North Platte in southeastern Wyoming and the Snake river in the northwest, streamflow will be less than normal in 1957. Adequate supplies will be available in the Snake river and the Green river and its tributaries. Some shortage may be expected in smaller Wind river tributaries in the Big Horn basin. Unless summer rainfall is above normal, shortages will occur east of the Big Horn mountains.

The irrigated area served directly by the North Platte should have an adequate supply if it receives average or better summer rainfall. As of April 1 soil moisture conditions were only fair. The Wheatland area on the Laramie river will not have an adequate supply. Streamflow will be slightly less than normal. There is no storage water available.

# # #

New Recreational Folder Available

A new recreational folder, entitled "Reclamation's Recreational Opportunities," has been published by the Bureau.

The folder lists 140 reservoirs on Reclamation projects throughout the 17 western States. It also contains information as to specific locations of these reservoirs, the name and location of the administering agency and specific facilities available, such as swimming, fishing, boating, hunting, camping, picnicking, and lodging. The folder also contains a map on which the name and location of each reservoir is indexed.

Copies may be purchased for 15 cents each or $9.50 per hundred from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

Water Stored in Western Reservoirs

(Operated by Bureau of Reclamation or Water Users except as noted)

Location	Project	Reservoir	Storage (in acre-feet)		
			Active capacity	Mar. 31, 1956	Mar. 31, 1957
Region 1	Baker	Thief Valley	17,400	18,900	17,400
	Bitter Root	Lake Como	34,800	17,400	11,800
	Boise	Anderson Ranch	423,200	115,200	208,300
		Arrowrock	286,600	182,600	276,300
		Cascade	654,100	211,700	358,800
		Deadwood	161,900	84,500	73,500
		Lake Lowell	169,000	143,200	143,100
	Burnt River	Unity	25,200	18,400	22,000
	Columbia Basin	F. D. Roosevelt	5,072,000	4,123,000	2,102,000
		Equalizing	761,800	742,700	528,900
		Potholes	470,000	258,000	307,500
	Deschutes	Crane Prairie	55,300	50,000	55,000
		Wickiup	187,300	200,000	200,000
	Hungry Horse	Hungry Horse	2,982,000	1,637,900	1,364,400
	Minidoka	American Falls	1,700,000	1,456,200	1,672,000
		Grassy Lake	15,200	12,700	13,900
		Island Park	127,200	110,300	122,900
		Jackson Lake	847,000	325,200	149,400
		Lake Walcott	95,200	96,300	102,400
	Ochoco	Ochoco	47,500	41,700	44,700
	Okanogan	Conconully	13,000	8,500	9,800
		Salmon Lake	10,500	9,500	9,500
	Owyhee	Owyhee	715,000	550,500	696,700
	Umatilla	Cold Springs	50,000	49,400	45,200
		McKay	73,800	57,900	52,400

Location	Project	Reservoir	Storage (in acre-feet)		
			Active capacity	Mar. 31, 1956	Mar. 31, 1957
Region 1	Vale	Agency Valley	60,000	49,400	58,700
		Warm Springs	191,000	115,100	192,800
	Yakima	Bumping Lake	33,700	3,200	27,100
		Cle Elum	436,900	181,100	367,000
		Kachess	239,000	141,900	206,700
		Keechelus	157,800	54,200	131,600
		Tieton	198,000	95,600	160,400
Region 2	Central Valley	Folsom	920,300	391,700	556,600
		Keswick	20,000	19,300	17,300
		Lake Natoma	8,800	8,300	6,900
		Millerton Lake	427,800	112,000	238,400
		Shasta	3,998,000	3,382,500	3,561,900
		Vermillion	125,100	[1]	[1]
	Klamath	Clear Lake	513,300	430,800	396,000
		Gerber	94,300	77,000	87,300
		Upper Klamath Lake	524,800	394,100	465,200
	Orland	East Park	50,600	50,200	49,900
		Stony Gorge	50,000	28,600	50,800
Region 3	Boulder Canyon	Lake Mead	27,207,000	10,720,000	11,502,000
	Davis Dam	Lake Mohave	1,809,800	1,718,000	1,689,700
	Parker Dam Power	Havasu Lake	688,000	616,000	639,200
	Salt River	Bartlett	179,500	68,000	123,000
		Horse Mesa	245,100	231,000	162,000
		Horseshoe	142,800	2,000	68,000
		Mormon Flat	57,900	57,000	50,000
		Roosevelt	1,381,600	229,000	159,000
		Stewart Mountain	69,800	66,000	63,000
Region 4	Eden	Big Sandy	38,300	9,800	11,100
	Fruitgrowers Dam	Fruitgrowers	4,500	2,300	1,800
	Humboldt	Rye Patch	190,000	40,200	63,100
	Hyrum	Hyrum	15,300	11,600	12,000
	Mancos	Jackson Gulch	9,800	2,200	900
	Moon Lake	Midview	5,800	5,200	4,800
		Moon Lake	35,800	11,200	9,300
	Newlands	Lahontan	290,900	197,400	251,900
		Lake Tahoe	732,000	480,000	597,600
	Newton	Newton	5,300	3,100	2,500
	Ogden River	Pineview	44,200	4,200	15,400
	Pine River	Vallecito	126,300	48,000	22,600
	Provo River	Deer Creek	149,700	86,600	82,700
	Scofield	Scofield	65,800	8,700	6,000
	Strawberry Valley	Strawberry Valley	270,000	152,600	141,800
	Truckee Storage	Boca	40,900	10,400	22,100
	Uncompahgre	Taylor Park	106,200	40,600	25,300
	Weber River	Echo	73,900	37,400	36,700
Region 5	W. C. Austin	Altus	162,000	35,700	8,900
	Balmorhea	Lower Parks	6,500	6,200	5,800
	Carlsbad	Alamogordo	122,100	85,000	4,600
		Avalon	6,000	900	2,500
		McMillan	38,700	32,100	17,400
	Colorado River	Marshall Ford	1,835,300	706,600	603,400
	Rio Grande	Caballo	340,900	10,700	4,200
		Elephant Butte	2,185,400	181,200	63,500
	San Luis Valley	Platoro	60,000	0	1,000
	Tucumcari	Conchas [2]	465,100	161,100	55,400
Region 6	Missouri River Basin	Angostura	92,000	8,400	33,500
		Boysen	710,000	2,500	192,600
		Canyon Ferry	1,615,000	1,154,500	1,012,400
		Dickinson	13,500	5,400	3,900
		Fort Randall	3,900,000	1,586,500	1,752,200
		Heart Butte	218,700	68,400	46,900
		Keyhole	130,000	20,800	2,600
		Shadehill	300,000	84,400	76,400
	Belle Fourche	Belle Fourche	185,200	98,800	49,900
	Fort Peck	Fort Peck [2]	14,877,000	416,700	1,743,700
	Milk River	Fresno	127,200	93,500	110,200
		Nelson	66,800	38,500	49,400
		Sherburne Lakes	66,100	23,100	21,100
	Rapid Valley	Deerfield	15,100	10,600	8,600
	Riverton	Bull Lake	152,000	55,300	63,200
		Pilot Butte	31,600	23,300	21,800
	Shoshone	Buffalo Bill	380,300	117,200	116,400
	Sun River	Gibson	105,000	74,600	41,900
		Pishkun	30,100	16,300	16,200
		Willow Creek	32,400	28,200	24,000
Region 7	Colorado-Big Thompson	Carter Lake	108,900	53,000	71,900
		Granby	465,600	31,100	37,800
		Green Mountain	146,900	40,500	50,200
		Horsetooth	141,800	69,300	91,400
		Shadow Mountain	1,800	1,300	1,500
	Missouri River Basin	Bonny	167,200	38,700	38,400
		Cedar Bluff	363,200	74,900	68,700
		Enders	66,000	35,300	34,100
		Harlan County [2]	752,800	92,600	66,100
		Harry Strunk Lake	85,600	24,700	27,700
		Swanson Lake	249,800	60,000	88,400
	Kendrick	Alcova	24,500	3,600	11,500
		Seminole	957,000	212,800	240,100
	Mirage Flats	Box Butte	30,400	19,500	16,700
	North Platte	Guernsey	39,800	32,400	[1]
		Lake Alice	11,200	1,200	10,900
		Lake Minatare	59,200	15,600	18,600
		Pathfinder	1,010,900	464,400	313,100

[1] Not reported.
[2] Corps of Engineers Reservoir.

HATFIELD CHILSON—NEW UNDER SECRETARY

HATFIELD CHILSON of Loveland, Colorado, was nominated as Under Secretary of the Interior on February 26, 1957.

Mr. Chilson has been Assistant Secretary for Public Land Management since October 29, 1956.

A prominent water attorney in the Rocky Mountain area, Mr. Chilson had been retained as attorney for the Colorado Water Conservation Board from 1954 until entering Federal service with the Department of the Interior. From 1949 until 1954 he was a board member of the Northern Colorado Water Conservancy District at Loveland. He served in 1946–48 as district attorney for the 8th Judicial District of Colorado, and had been city attorney for Estes Park since 1936. He has been a member of the American Bar Association since 1937, and was admitted to practice before the United States Supreme Court 1954. He was a member of the Colorado State Board of Law Examiners for 3 years.

Mr. Chilson was one of the leaders in organizing the Big Thompson Conservation District in northern Colorado, and participated prominently in the successful effort for enactment of the Colorado River Storage Project legislation. He was born in Pueblo, Colorado, on November 22, 1903, and earned his law degree from the University of Colorado in 1927. He was admitted to the bar in his native State the same year.

His extensive legal as well as administrative background qualify him thoroughly for the second ranking position of the Interior Secretariat.

Mr. Chilson married the former Marian Cole, and they have one son, John Hatfield Chilson, a student at Dartmouth College, Hanover, New Hampshire. #

COOPERATION AT COLORADO A & M

Colorado A & M College's civil engineering department and the U. S. Geological Survey have been granted a $25,000 fund by the U. S. Department of the Interior to finance a study being carried out in the college's hydraulics laboratory.

Everett V. Richardson of USGS is the project leader for that agency and Dr. Maurice L. Albertson, professor of civil engineering, is the college's representative in charge of the project. Albertson has been a part-time consultant to USGS over the past 10 years. During that time his research has continued, both in the A & M laboratories and under field conditions, on the flow of water in open channels such as irrigation canals, natural streams and rivers, drainage canals, and hydroelectric power and navigation channels.

This research eventually demonstrated a possible means of reaching long-needed solutions to the problems involved in designing artificial open channels and in regulating natural streams. One such problem heing studied intensively at A & M under the new grant is that of the sediment (silt, sand and gravel) encountered in diverting water and in building storage reservoirs, diversion canals and other structures associated with the control and conveyance of water.

Another major problem rating immediate attention is the designing of stable channels that will retain their shapes and require little maintenance. Successful design will greatly lower costs of the initial construction and the maintenance of irrigation canals.

Other research now under way at A & M will greatly increase the accuracy of the "Water Supply Papers" published by the U. S. Geological Survey.

Eighty-four Years Of Reclamation

Above: JAMES C. BEVERIDGE, the Bureau's Records Officer, pictured with Commissioner W. A. Dexheimer at a farewell luncheon upon his retirement after completing 44 years of service with the Bureau. Below: DONOVAN S. "PAT" KOONTZ, Attorney in the Solicitor's Office, shows Mrs. Koontz the gifts he received at a farewell luncheon upon his retirement after 42 years of Government service, 40 of which were spent with the Bureau of Reclamation.

Population Trends

The following data have been excerpted from The Kiplinger Washington Letter of December 22, 1956:

Total population of the United States grows so fast you lose track of it. 40 years ago, 100,000,000. 10 years ago, 141,000,000. Now 170,000,000. By 1957, 221,000,000 . . . and that's a lot of people to be fed, clothed, housed, and otherwise serviced . . . potential customers within our system. A lot of people to do the work, too . . . as they mature and become able. People will overflow the landscape around the cities . . . farther than now. They will migrate to new places, and fill up areas now sparsely settled. They will lead new lives of their own . . . with new patterns, new standards.

Where People Are Moving To—and From

Now look at growingest areas of United States: Florida, fastest growing of the big States, percentagewise . . . up 36 percent past 6 years. Means addition of 1,000,000 people. California, up 27 percent in the past 6 years. But this adds some 2,900,000 people. Mountain States, well up. Nevada 55 percent; Arizona 41 percent; Colorado 22 percent; New Mexico 20 percent; Utah 18 percent. Other fast-growing States: Delaware 26 percent; Maryland 20 percent; Michigan 18 percent; Texas 16 percent; Ohio 15 percent; Oregon 13 percent; Indiana 12 percent; Washington 12 percent; Louisiana 12 percent. Lagging behind the average of United States: New England, excepting only Connecticut. Others lagging: New York, Pennsylvania, North Carolina, Georgia, Illinois, Wisconsin, Minnesota, Iowa, Nebraska, Dakotas, Montana, Idaho, Missouri, Oklahoma, Kentucky, Tennessee, Alabama. Actually losing population: Maine, Vermont, West Virginia, Mississippi, Arkansas. States not listed are near United States average . . . 11 percent in past 6 years. #

U. P. Movie Available

"Fresh From the West," a new Union Pacific Railroad movie depicting the harvest, packing and shipping of fresh vegetables from the irrigated West, is now available for loan to groups interested in irrigation. Prints are obtainable from Joe Jarvis, UP Agricultural Agent at 1416 Dodge Street, Omaha, Nebraska. #

Cachuma's Recreation

Continued from page 29

on recreational use of the reservoir. That was in October 1952. The Board of Supervisors, following the citizens' conference and publication of the master plan, held a public hearing at which there was wide representation from many segments of the community. Support for county administration was practically unanimous. The Board of Supervisors, following the public hearing, established a park division in the County Public Works Department and created a Park Commission to advise the division on matters of policy. A county park superintendent was employed by the Board to assume direct responsibility for administration of the area.

Operation and development began in 1953. About $100,000 was invested in 1953–54 for capital improvements, and a system of fees and charges for entry to the area and for use of the facilities was established. Concessions were let for boat rental and related services. The reservoir has not yet filled and good pasture on the exposed lake bed areas has been utilized through grazing leases providing additional revenue. Revenues from this source will be reduced as the reservoir fills but revenues from recreation should increase.

Cachuma reservoir is designed for long-term hold-over storage. Since the dam was completed 4 years ago, drought has prevailed and the reservoir has not filled. Recreational use, however, has increased each year. The story is best summarized in the following tabulation of receipts from fees and charges and of the costs for development, operation and maintenance:

REVENUES

	1953–54	1954–55	1955–56	Totals
Season passes	$9, 157. 00	$13, 466. 50	$17, 157. 00	$39, 780. 50
Camping permits	1, 086. 00	4, 839. 45	12, 300. 70	18, 226. 15
Boat licenses	1, 714. 96	8, C94. 00	11, 825. 00	21, 633. 96
Parking fees	4, 528. 00	14, 683. 44	22, 668. 30	41, 879. 74
Concessions	967. 71	3, 842. 93	8, 437. 81	13, 248. 45
Grazing leases	4, 593. 60	5, 493. 89	6, 337. 44	16, 424. 93
Total revenues	22, 047. 27	50, 420. 21	78, 726. 25	151, 193. 73
Operation and maintenance	21, 096. 33	39, 640. 39	50, 262. 33	[1] 110, 999. 05
Depreciation (Using 15-year average life on capital outlay valued at $183,273.19)				26, 472. 74
Total costs including depreciation				137, 471. 79
Net revenue for 3 years of operation				13, 721. 94

[1] This does not include costs to the County for Administration other than at the Park, or costs of work by the Public Works Department Maintenance Division.

More than 80 percent of the 593,000 visitors to Cachuma come from Los Angeles and its environs. Through payment of fees they contribute toward the development and maintenance of the area, thus relieving the county of what would otherwise be an unfair burden.

Before concluding that all reservoir areas can be as successfully operated as Cachuma a word of caution is in order. At Cachuma the terrain favors controlled access to the area at a single point, thus simplifying collection of fees and reducing collection costs. Many reservoirs have several logical points of access and collection costs could be high in proportion to receipts, unless recreational use is extremely heavy. Scattered development also means high costs for capital outlay, again excepting those locations where the use of each developed area approaches a maximum. Each reservoir thus becomes a special development and management problem. Nevertheless, the experience at Cachuma should be valuable to those agencies which are managing or which expect to manage recreation at reservoir areas. # # #

BOOKS

IRRIGATION ENGINEERING

VOLUME II

by Ivan E. Houk

John Wiley & Sons, Inc.

New York

The second volume of IRRIGATION ENGINEERING, by Ivan E. Houk, has recently been published by John Wiley & Sons, Inc.

Now a consulting engineering in Denver, Mr. Houk was for many years on the staff of the Assistant Commissioner and Chief Engineer of the Bureau of Reclamation of the Department of the Interior.

The first volume of this work, published in 1951, dealt with the hydrological and agricultural phases of irrigation engineering.

The second volume emphasizes the practical requirements that must be kept in mind in evaluating irrigation feasibilities, planning irrigation projects, designing structures, and constructing all features of irrigation systems. It includes discussions of necessary land and water studies and of project settlement problems, as well as chapters dealing with water conveyance and distribution systems and with all types of structures.

WATER FOR AMERICA

The Story of Water Conservation

by Edward Graham and William Van Dersal

This is a comprehensive survey of water conservation in America—what has been done and what remains to be done. And it is a remarkable story about one of the most important substances on earth—a substance that we take for granted, yet one that all living things depend on for continuing life.

In a topical presentation the authors have included here the importance of water and our dependence on it, how it is used in industry, on the farm and in the home, what the methods of conservation are, the importance of conservation, and the pleasure water gives. The photographs, facing each page of text, dramatize and enhance the factual material.

OXFORD UNIVERSITY PRESS

DO YOU KNOW:

That Glen Canyon Dam on the Utah-Arizona border, only a few miles above Lee Ferry, will create a reservoir which will be capable of storing 26 million acre-feet of water.

This is more than enough to cover the entire State of Rhode Island 30 feet deep.

LETTERS

ORGANIC FARMING!

Dear Sirs: Would you please favor me with a copy of your November issue. A group of farmer friends in Mexico would like to read the article re Gillett's organic culture.

(Sgd.) P. A. Ingrason
c/o Hotel McCoy
El Paso, Texas.

Dear Sirs: I read with great interest the article in the November issue on Mr. Gillett's organic method of farming. I hope to see more articles along this line, as I believe this natural method will have a very beneficial influence on the health of the soil and on our own health.

Sincerely,
(Sgd.) L. Fencl
Our Lady of Lourdes Mission
Porcupine, South Dakota.

We will try to fill your request in an early issue.—Ed.

GRASSLANDS

Continued from page 42

This type of information greatly helps ranchers to judge the condition of their ranges and to be aware of whether their range is improving or degenerating. For example, a pasture which was mostly buffalo grass would probably have a past history of heavy grazing. Buffalo grass is a good grass, but it simply will not produce as much forage as some of the taller grasses (Table 2). When increasers such as buffalo grass start replacing decreasers such as big bluestem, a rancher knows that his range is degenerating.

Information of this kind should be obtained all over the country where native grasslands are an important part of the economy. Areas such as the one set aside by the Bureau of Reclamation at Cedar Bluff Reservoir are a necessity in obtaining such information. These areas must be set aside soon or prairies such as this one will disappear, and we will soon forget what our native climax grasslands were like. ###

Table 2. *Forage yields (lbs. per acre) of principal species of grass on different sites of Cedar Bluff prairies (1952)*

Grasses	Upland	Breaks	Lowland
Buffalo grass	1,253	1,548	0
Blue grama	1,337	980	0
Side-oats grama	1,667	1,186	0
Western wheatgrass	2,097	0	4,941
Big bluestem	3,804	2,410	6,013
Little bluestem	0	2,406	0
Switch grass	0	0	5,873

MAJOR RECENT CONTRACT AWARDS

Spec. No.	Project	Award Date	Description of Work or Material	Contractor's Name and Address	Contract Amount
DS-4764	Missouri River Basin, S. Dak.	Jan. 8	One 75,000/100,000/125,000-kva (230/161-kv) autotransformer for Sioux City substation.	Legnano Electric Corp., New York, N. Y.	$168, 500
DC-4774	Columbia Basin, Wash	Mar. 4	Construction of earthwork and structures for Royal Branch canal laterals, wasteways, and drains, Block 85.	Cherf Brothers, Inc. and Sandkay Contractors, Inc., Ephrata, Wash.	888, 968
DC-4779	Colorado River Storage, Utah-Wyo.	Jan. 4	Construction of earthwork, structures, bridge, and surfacing for temporary access road to Flaming Gorge Dam, Sta. 0 + 00 to 402 + 00.	Wangsgaard Construction Co., Logan, Utah.	143, 912
DC-4783	Missouri River Basin, Mont.	Mar. 8	Construction of Helena Valley pumping plant	Misco-West Coast, Seattle, Wash.	1, 056, 383
DC-4786	Missouri River Basin, Neb.-Kansas.	Jan. 14	Construction of earthwork and structures for Courtland canal, Sta. 2472 + 48 to 2809 + 00; Miller canal, Sta. 0 + 00 to 456 + 32.4, and laterals, wasteways, and drains.	Bushman Construction Co., St. Joseph, Mo.	1, 014, 168
DC-4792	Missouri River Basin, Kansas.	Jan. 18	Construction of earthwork and structures for Kirwin South canal, Sta. 0 + 52 to 860 + 50, laterals, and drains.	Bushman Construction Co., St. Joseph, Mo.	990, 261
DC-4793	Missouri River Basin and Kendrick projects, Wyo.	Jan. 17	Construction of earthwork, structures, bridge, and surfacing for access road to Fremont Canyon powerplant and surfacing Alcova powerplant access road and parking area.	Knisely-Moore Co., Douglas, Wyo.	479, 353
DS-4795	Missouri River Basin, Mont.	Mar. 21	Two vertical-shaft, 5,000-hp, 325-rpm hydraulic turbines and two vertical-shaft centrifugal pumps for Helena Valley pumping plant.	James Leffel and Co., Springfield, Ohio.	345, 270
DC-4800	Colorado River Storage, Ariz.-Utah.	Jan. 21	Construction of Colorado River bridge for Glen Canyon Dam	Kiewit-Judson Pacific Murphy, Emeryville, Calif.	4, 139, 277
DC-4801	Missouri River Basin, Wyo.	Feb. 14	Construction of Fremont Canyon powerplant and power conduit.	Coker Construction Co., Peter Kiewit Sons' Co., and Condon-Cunningham, Inc., Omaha, Nebr.	14, 434, 000
DC-4803	Central Valley, Calif	Feb. 12	Construction of Clear Creek tunnel	The Shea Co., Henry J. Kaiser Co., Morrison-Knudsen Co., Inc., Macco Corp., and Raymond Concrete Pile Co., Alhambra, Calif.	36, 644, 556
DC-4804	Central Valley, Calif	Feb. 11	Construction of earthwork, structures, and surfacing for county road improvements from Trinity River bridge to Trinity Dam.	Monte W. Brown, Redding, Calif.	792, 423
DS-4805	Colorado River Storage, Ariz.-Utah.	Jan. 4	Materials for 100-foot by 320-foot steel warehouse for Glen Canyon Dam and powerplant.	Allison Steel Mfg. Co., Phoenix, Ariz.	164, 081
DC-4807	Eden, Wyo	Jan. 30	Construction of earthwork and structures for laterals and drains in Farson area and drains in West Side area.	Asbell Brothers Construction, Riverton, Wyo.	940, 608
DC-4819	Missouri River Basin, Neb.	Feb. 1	Construction of Culbertson canal siphons, Sta. 300+60 to 690+15, using monolithic concrete in siphon barrels, Schedule 1.	Adler Construction Co. Rapid City, S. Dak.	678, 833
DC-4824	Central Valley, Calif	Mar. 8	Construction of Trinity Dam	Guy F. Atkinson Co., M. J. Bevanda, Charles L. Harney, Inc., Ostrander Construction Co., A. Teichert and Son, Inc., and Trepte Construction Co., Inc., South San Francisco, Calif.	48, 928, 101
DC-4829	Chief Joseph Dam, Wash	Mar 12	Construction of earthwork, pipelines, and structures for Brewster Flat distribution system, Brewster Flat Irrigation District.	Hanning and Gonzales, Portland, Oreg.	433, 833
DC-4831	Missouri River Basin, Wyo.	Mar. 27	Construction of Anchor Dam (concrete) and access road	Foley Brothers, Inc., St. Paul, Minn.	2, 289, 052
DS-4836	Santa Maria, Calif	Mar. 26	Four 7-foot by 12-foot outlet gate valves for outlet works at Vaquero Dam.	Goslin-Birmingham Mfg. Co., Inc., Birmingham, Ala.	348, 750
100C-253	Michaud Flats, Idaho	Mar. 13	Construction of pipe laterals for Areas 1 and 3	Mel Brown Co., Idaho Falls, Idaho	157, 411
100C-275	Minidoka, Idaho	Jan. 22	Construction of earthwork and structures for Unit B relift pumping plants and laterals from 20 wells.	Olof Nelson Construction Co., Logan, Utah	167, 633
100S-276	Minidoka, Idaho	Feb. 12	Sixteen pumping units for wells	Layne and Bowler, Inc., Memphis, Tenn.	172, 528
117C-416	Columbia Basin, Wash	Mar. 7	Construction of earth and concrete lining and structures for East Low canal laterals, Block 18.	Cherf Brothers, Inc. and Sandkay Contractors, Inc., Ephrata, Wash.	107, 738
117C-420	Columbia Basin, Wash	Mar. 21	Construction of earthwork for deep drains, Blocks 41, 42, and 43.	Duncan Construction Co., Moses Lake, Wash.	133, 445
400C-72	Weber Basin, Utah	Feb. 14	Construction of earthwork and structures for Syracuse (B-5) drain.	R. W. Coleman Co., Ogden, Utah.	144, 500
701C-429	Missouri River Basin, Nebr.	Mar. 4	Construction of earthwork and structures for additions and extensions of Bartley and Cambridge canals and laterals.	Bushman Construction Co., St. Joseph, Mo.	154, 871

Construction and Materials for Which Bids Will Be Requested Through June *

Project	Description of work or material
Central Valley, Calif.	Constructing a 102-inch precast concrete pipe siphon, 83 feet of which will be in a tunnel under the Southern Pacific Railroad; 50 feet is to be jacked under U. S. Highway 99W and about 102 feet laid in open trench for the Corning Canal, south of Red Bluff.
Collbran, Colo	Constructing the 144-foot-high Vega earth dam and appurtenant structures, and relocating about 5 miles of county road. About 10 miles east of Collbran.
Colorado-Big Thompson, Colo.	Furnishing and installing an electrical fish screening device 160 feet long with depth varying from 5 to 20 feet in Willow Creek Reservoir at the intake to the Willow Creek Pump Canal, about 8 miles north of Granby.
olorado River Storage, Ariz.	Constructing a one-story light steel frame municipal building about 224 feet long and 36 feet wide, a one-story wood-frame laboratory building about 54 feet long and 39 feet wide, a 360- by 144-foot steel frame administration building, a 160- by 48-foot steel frame fire, police headquarters building, a 225- by 36-foot steel frame dormitory, a 150- by 70-foot steel frame garage, a sewage treatment plant and about 290 residences and facilities for a 2,000-person community at Glen Canyon. Work will include streets, water and sewer main. About 120 miles north of Flagstaff, Arizona, and 70 miles east of Kanab, Utah.
Do	Constructing base course and bituminous surfacing, and guardrail for 25 miles of access highway from Bitter Springs to Glen Canyon Dam site, about 120 miles north of Flagstaff.
Do	Oiling 7 miles of road to the Arizona-Utah State Line, constructing 0.75 mile of access road, and constructing and surfacing Vista Point parking area at Glen Canyon Dam site, about 70 miles east of Kanab, Utah.
Colo. River Storage, Utah.	Constructing about 80 residences, facilities including streets, sewage collection system, and a water distribution system for a 1,000-person community, a 105- by 36-foot wood-frame administration building, a 39- by 54-foot wood-frame laboratory, a 100- by 30-foot concrete masonry garage and fire station, and a 24- by 60-foot wood-frame conference hall. At the Flaming Gorge Community, about 40 airline miles north of Vernal.
Do	Constructing 7.5 miles of bituminous-surfaced access road to left abutment of Flaming Gorge Dam, about 40 airline miles north of Vernal.
Do	Constructing a pumping plant building and installing two 250 gpm pumping units with a head of 800 feet, and chlorination equipment; furnishing and installing 13,300 feet of 6-inch insulated discharge line on piers, 2,500 feet of 8-inch supply line to community, and constructing a 250-foot pipe suspension over the Green River and a 500,000-gallon steel water storage tank. At the Flaming Gorge Community, about 40 airline miles north of Vernal.
Columbia Basin, Wash.	Constructing about 3 miles of 12-foot bottom width concrete-lined Wahluke Canal. South of Othello.
Do	Constructing the 165- to 29-cfs-capacity wasteway channel about 9 miles long, 15 miles west of Mesa.
Do	Constructing 7 drains and one pumping plant in Block 45, near Othello.
Do	Constructing pumping plants near Ephrata and Othello.
Do	Constructing and deepening drains near Warden, Othello, Moses Lake, Quincy, and Ephrata.
Do	Constructing two 3-bedroom frame residences with separate double garage; two 2-bedroom frame residences with attached garages and full basements; constructing an office building, storehouse, general purpose shop, equipment shelter building; one 2-bedroom frame residence with attached garage and full basement; two 2-bedroom frame residences with full basements, a separate 2-car garage, and one pumphouse in Block 81, near Quincy, Burke, Moses Lake, and Smyrna.
Grants Pass, Oregon.	Constructing fish screening device ahead of pump intake structure at right end of the Savage Rapids Dam, east of Grants Pass.
Kendrick, Wyo	Earthwork and structures for about 8 miles of open drains, near Casper.
Middle Rio Grande, N. Mex.	Removing spoil piles along the settling channel; cleaning, rehabilitating and providing for power operation of the gates at the dam; constructing a concrete skimmer wall in canal intake structure; a reinforced concrete training wall 10 feet high and 100 feet long in sluiceway channel, and driving steel sheet piling for 350 feet of training walls in the Rio Grande River channel, upstream from the dam. Angostura Diversion Dam, north of Bernalillo.
Middle Rio Grande, N. Mex.	Clearing and cleaning about 9.5 miles of laterals and constructing turnouts, checks, drops, culverts, siphons, drainage inlets and wasteways. Belen Unit 3, between Isleta and Belen.
Minidoka, Idaho	Earthwork and structures for about 7 miles of open laterals with bottom widths of from 4 to 2 feet, from 14 wells. Near Rupert.
Do	Completing 5 Unit B relift pumping plants including furnishing and installing electrical equipment, on the North Side Pumping Division.
Do	Installing pumping units, furnishing and installing complete electrical systems and other minor miscellaneous completion work for 57 deep irrigation wells. Near Rupert.
MRBP, Mont	Earthwork and structures for about 23 miles of 16- to 6-foot bottom width earth canal with about 4 miles of compacted earth lining and about one mile of concrete lining. Helena Valley Canal, near Helena.
MRBP, Neb	Earthwork and structures for about 38 miles of canal with bottom widths varying from 16 to 3 feet and about 35 miles of unlined laterals with bottom widths varying from 6 to 3 feet. Near McCook.
MRBP, Wyo	Two 25,263-kva, 0.95 power factor, 11,500-volt, 257-rpm, vertical-shaft, hydraulic-driven, indoor-type, synchronous generators for the Fremont Canyon Powerplant.
Rogue River Basin, Oreg.	Constructing the 67-foot-high Keene Creek Earth Dam and appurtenant structures; the 6-foot-diameter, 2,100-foot-long, concrete-lined Cascade Divide Pressure Tunnel; 4,250 feet of 60-inch-diameter monolithic concrete, precast concrete pipe or steel pipe pressure conduit; and the 6-foot-diameter, 5,000-foot-long concrete-lined Green Springs Pressure Tunnel. About 16 miles by road southeast of Ashland.
Do	Constructing about 8 miles of the 60-cfs-capacity concrete-lined Howard Prairie Delivery Canal, including about 3 miles of reinforced concrete rectangular flume section, a 48-inch concrete pipe siphon about 1,200 feet long and the earth and rockfill Little Beaver Creek Diversion Dam. Near Ashland.
Do	Constructing the outdoor-type, single-unit Green Springs Powerplant, penstock and switchyard. About 11 miles southeast of Ashland.
Do	Clearing about 2,000 acres, including about 490 M f. b. m. of merchantable timber of mixed species. Howard Prairie Reservoir site, about 27 miles east of Ashland.
Do	Constructing buildings and camp facilities at Howard Prairie Dam, near Ashland.
Solano, Calif	Constructing about 8.7 miles of 7-foot bottom width concrete-lined canal, including monolithic concrete box siphons, precast concrete pipe siphons, turnouts, checks, culverts and bridges. Putah South Canal, west of Fairfield.
Ventura River, Calif.	Work will include constructing a 500-foot-long rock weir, a 60-foot-wide gated spillway, a 500-cfs-capacity canal headworks, a Parshall flume, a concrete-lined canal 5.25 miles long, with culverts, drainage inlets and bridges, a 78-inch-diameter siphon, and a reinforced concrete chute-drop terminal structure into Casitas Reservoir. Robles Diversion Dam and Robles Casitas Diversion Canal, north of Ventura.
Do	Earthwork and structures for 25,800 feet of 42- and 54-inch precast concrete cylinder pipe line and 141,700 feet of 12- to 39-inch precast concrete pipe (pretensioned) or mortar-lined and mortar-coated steel pipe lines. Near Ventura.
Weber Basin, Utah.	Earthwork and structures for about 15 miles of Uintah Bench Laterals of precast concrete pipe, modified prestressed steel cylinder pipe, mortar-lined and coated steel pipe and cast iron pipe or asbestos-cement pipe; 2 small reservoirs; and one pumping plant with 4 outdoor, horizontal booster units. South of Ogden.
Do	Constructing about 4 miles of precast concrete pipe line and a concrete-lined equalizing reservoir. Davis Aqueduct Trunk Lines, near Salt Lake City.
Do	Constructing the 37,600-foot-long Willard Dike averaging 3 feet high and 40 feet wide, excavating drains, constructing corrugated metal pipe drainage structures, and grading and surfacing an access road. Southwest of Willard.

* Subject to change.

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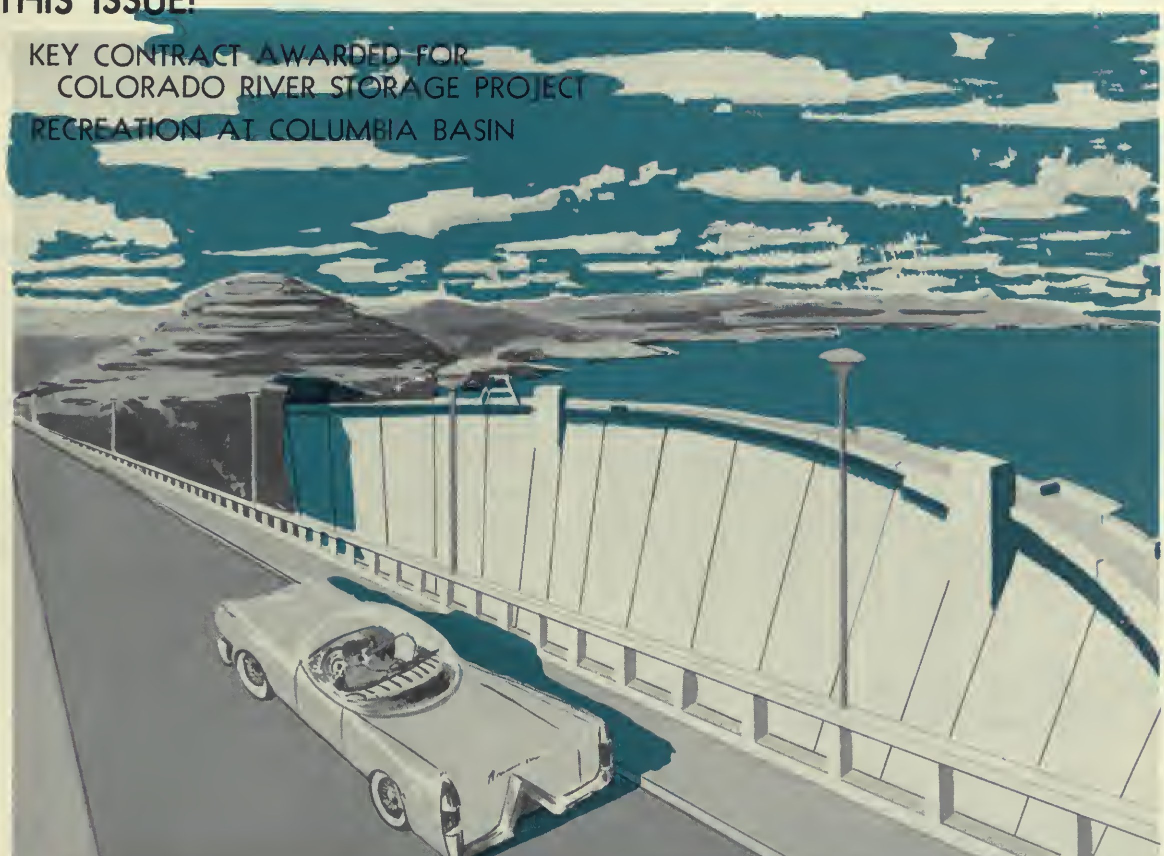
The Reclamation Era

AUGUST 1957

IN THIS ISSUE:

KEY CONTRACT AWARDED FOR COLORADO RIVER STORAGE PROJECT

RECREATION AT COLUMBIA BASIN



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The Reclamation Era

AUGUST 1957

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In this issue . . .

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* * *

Thirty Years Ago in the Era

May 10, 1927, was a gala day for Oregon. Federal and State authorities, engineers, a good representative group of farmers and their families, and businessmen journeyed to the McKay Dam to take part in the celebration marking the release of the first storage water from the McKay Reservoir.

DESIGN AND ILLUSTRATIONS by Drafting and Graphics Branch
Bureau of Reclamation, Washington, D. C.

J. J. McCARTHY, Editor

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Key Contract Awarded for
Colorado River Storage Project

by C. H. CARTER,
Assistant Regional Director, Region 4,
Bureau of Reclamation,
Salt Lake City, Utah

With the opening of bids on the prime contract for Glen Canyon Dam, the Bureau of Reclamation launched the $938 million Upper Colorado River development program. Bids were opened on April 11, 1957—exactly 1 year to the day after President Dwight D. Eisenhower signed Public Law 485 authorizing construction of the initial four storage units of the Colorado River storage project and the initial 11 participating projects.

Kanab, a small picturesque town in southern Utah, where the Hollywood film producers make cowboy movies on location, was the site of the bid opening. The Bureau of Reclamation office in the old school building was obviously too small to accommodate the bid opening crowds so bids were opened in the gymnasium of the new Kanab High School, where the decorations for a high school dance set the scene for what must have been the Bureau's most festive bid opening.

While the locale was outwardly festive, 750 people had assembled to witness the opening of bids for the largest single contract in the history of the Bureau of Reclamation.

A tenseness filled the air! How high would the bids run? What would happen if bids were way above the engineer's estimate? Would the Upper Colorado River program be delayed? These, and scores of other questions were heard on every hand.

Finally, the 10 a. m. bid opening time arrived, and the time-honored, machinelike procedures began. By chance, the first bid read by L. F. (Lem) Wylie, project construction engineer for Glen Canyon Dam, was the low bid submitted by Merritt-Chapman and Scott of New York, $107,955,122!

With this short announcement, the Upper Colorado River basinwide development was launched. Glen Canyon Dam—the key to the entire development—was assured. The third highest dam in the world with the third largest reservoir in the world and the seventh largest hydroelectric powerplant in the United States would be built.

Two additional joint-venture bids of about $118 million and $120 million were received; but Merrit-Chapman and Scott's bid of $108 million—more than $27 million below the engineer's estimate of $135,608,170—was the best. The contract was awarded and notice to proceed issued on April 29.

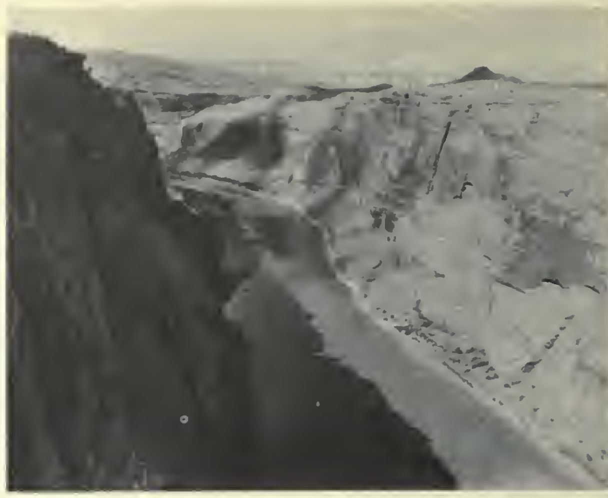
Upper left: William Denny, (left) vice president, Merritt, Chapman & Scott; and L. F. Wylie, construction engineer, following bid opening. Upper right: Bids opened before audience of over 700 interested spectators. ***Photo by F. B. Slote, Region 4.***

Glen Canyon Dam is located on the Colorado River in Arizona at the lower margin of the Upper Colorado River Basin. At this point, Glen Canyon Dam can store the erratic flows of the Colorado River to assure steady releases to the Lower Colorado River Basin in accordance with the Colorado River Compact. Only with this control of the Colorado River can upstream diversions for beneficial, consumptive uses on a large scale be made every year, year-in and year-out.

Power revenues from the Glen Canyon Dam powerplant of 900,000 kilowatts will repay about 75 percent of the $938 million cost of initially authorized works plus interest on the power investment. Revenues from the sale of Glen Canyon power will be placed in the basin fund along with revenues from other sources to repay in full all reimbursable costs.

Merritt-Chapman and Scott's bid of $108 million on the prime contract for Glen Canyon Dam clearly assumes great significance. Glen Canyon Dam, which is the essential feature of the Upper Colorado Basin plan of development, is now under construction. Flaming Gorge Dam in Utah, Navajo Dam in New Mexico, and the Curecanti unit of several dams in Colorado will be undertaken in timely progression. Flaming Gorge Dam and Reservoir will provide about 4 million acre-feet of storage and 100,000 kilowatts of installed generating capacity; Navajo Dam and Reservoir, more than 1½ million acre-feet of storage; and the Curecanti unit, 1¼ million acre-feet of storage and 152,000 kilowatts of installed generating capacity.

Placing steel in north right portal of tunnel. ***Photo by F. S. Finch, Region 4.***



View of Glen Canyon where water will be several hundred feet deep after completion of the dam.

Construction work at the Glen Canyon damsite began with the first blast of rock from the right canyon wall on October 15, 1956, as President Eisenhower gave the signal from his desk in Washington, D. C., in a historic telephone network ceremony. The Mountain States Construction Co. of Denver, Colo., thus began work on a $2.5 million contract awarded on October 1, for excavating the right diversion tunnel. As this is written in May 1957, more than 1,000 feet of the approximately 45-foot diameter tunnel had been driven. Completion of the 2,768-foot-long tunnel is scheduled for December 1957.

Access road construction to the Glen Canyon damsite was started immediately. An alternate route for U. S. Highway 89 received prompt approval. This alternate highway will leave the present U. S. 89 at Bitter Springs, Ariz., reach northward 25 miles to the Glen Canyon damsite; cross Glen Canyon on the highest steel arch bridge in the United States; and extend generally westward 72 miles to join with U. S. 89 at Kanab, Utah.

The 25 miles of primary highway from Bitter Springs to the damsite will be completed and surfaced by late fall of 1957 at a total cost of about $3,700,000.

The 1,271-foot long, 700-foot high, 38-foot wide steel arch bridge across Glen Canyon, about 900 feet downstream from the damsite, is under contract for $4,139,277 to the Kiewit-Judson Pacific Murphy combine. Work on the bridge abutments is now well under way. Completion of the bridge is scheduled for early in 1959. The "hanging" of

3,500 tons of structural steel across this chasm will be a spectacular undertaking.

A 7-mile graveled road has been built by the Bureau of Reclamation from the damsite to the Utah-Arizona State line. It is expected that the State of Arizona will bring this road up to primary highway standards at an early date.

The State of Utah will soon have all of the remainder of the new Alternate U. S. 89 from the State line to Kanab under construction contracts.

A new town, which has been named Page, Ariz., (after former Commissioner of the Bureau of Reclamation John C. Page), is now under construction on Manson Mesa about 2 miles from the damsite on the southeast side of the Glen Canyon. Estimates of peak population for Page, in which Government and contractor personnel will live, range from 8,000 to 12,000. The nearest existing towns are Flagstaff, Ariz., (also the closest railhead), which is 135 miles from Glen Canyon damsite and Kanab, Utah, 72 miles.

Clearing Bittersprings Road, drilling bridge abutment; and *lowering construction equipment into Glen Canyon.* Photos *by F. B. Slote, and F. S. Finch, Region 4.*

Merritt-Chapman and Scott's $108 million prime contract calls for the following major work items: (1) Drilling of left diversion tunnel, (2) lining both left and right diversion tunnels, (3) building two cofferdams to divert the river during construction, (4) constructing the concrete dam from bedrock to crest, (5) constructing the powerhouse and related features, and (6) drilling and lining the spillway tunnels. A total of 5,200,000 cubic yards of concrete will be placed in the Glen Canyon Dam and appurtenant works, with 4,770,000 of that total in the dam proper.

The steel in reinforcing concrete, in penstocks and outlets, and in many other installations will total 35,340 tons—a quantity of steel sufficient to produce more than 20,000 low-priced automobiles.

The time allowed for completion of the prime contract is 2,500 days, or nearly 7 years. A completion contract will be entered into to finish construction of the powerhouse, including installation of the generating equipment.

Glen Canyon Dam is a truly great engineering undertaking. It will rank with Hoover and Grand Coulee Dams which have been acclaimed by the American Society of Civil Engineers as two of the seven modern engineering wonders of the United States.

But great as Glen Canyon Dam will be as an engineering wonder, its greatest worth is found in the benefits which it creates by making the entire Upper Colorado River Basin development possible.

Completion of the initially authorized 4 storage units and 11 participating projects will create benefits estimated to total about $57 million annually! These benefits will result by making abundant water and power resources available to the upper basin States of Colorado, New Mexico, Wyoming, and Utah. Irrigation and industrial developments utilizing water and power will produce the primary benefits.

Population estimates reveal clearly the significance of the benefits to be achieved in the upper basin States. The present population of the upper basin States is nearly 3½ million people. By 1975, the population of this intermountain empire is expected to reach about 5,200,000 without the Upper Colorado development. But, it is estimated that development of the upper Colorado River Basin will swell the population by another 1 million persons, bringing the anticipated 1975 population to 6,200,000 people or nearly double the present population!

The real benefits of any resource development are revealed in terms of economic opportunities for people; the creation of economic support for

Continued on page 73

Weeds Move Faster Than People

Weeds are synonymous with irrigation. The history of irrigation and the weed problems of mature irrigation projects are proof of that hypothesis. Men of vision recognize, as did Jethro Tull, when he wrote in 1731, "It is needless to go about to compute the value of damage the weeds do, since all experienced husbandmen know it to be very great, and would unanimously agree to extirpate their whole race as entirely as in England they have done to wolves, though much more innocent and less rapacious than weeds."

The agricultural leaders of Grant County recognized the weed potential of the land when it is irrigated. Three years prior to the delivery of water to the Columbia Basin project farm leaders of the county which had at that time fewer than 100 irrigated farms, compared to the present potential of more than 6,000, met with representatives of State, county, railroad, farm organizations and others interested in the project, to discuss methods of organizing "A Weed District." Farmer and businessmen committees were appointed for the county as a whole and for the communities of Moses Lake and Quincy. These committees functioned as best they could under the circumstances. It was difficult to convince the owners of this potentially irrigated land of the threat of weeds. Without visible evidence of the existence of weeds the majority could not be convinced that a threat was manifest.

In 1951, the State Crop Improvement Association, acting through the County Crop Improvement Association, advocated the production of Foundation, Registered and Certified seeds in this area. There developed a kindredship between the Crop Improvement Association and the weed committees that had been working for years to make the people "weed conscious." It was necessary for weed control to become an integral part of farm management if the area was to retain its advantage in seed production. In 1953, the Crop Improvement Association, with the aid of farm leaders and United States Bureau of Reclamation officials equally concerned with weed control, met with the county commissioners and requested that a county extension agent be hired who would devote the major portion of his time to the development of a countywide weed control program. The Commissioners were in agreement; they recognized the need; and in February of 1954, the author began working toward such a goal.

A program that would be felt immediately and yet have sufficient value to grow with the basin as new farms were developed would necessitate the tying together of many varied interests. A meeting, attended by area representatives of the Bureau of Reclamation, the Fish and Wildlife

by BEN ROCHÉ

Grant County Extension Service Weed Specialist Grant County, Wash.

Service, the State Game Department, the Soil Conservation Service, the Parks and Recreation Department, the State College of Washington, the County Engineers Office and the County Extension Service, was held. The many phases of weed control were discussed. Many actions, each of which would make a good story, have come about directly or indirectly from this interagency discussion. Recognizing that people pass through definite stages in the acceptance of anything new, namely: Awareness, interest, evaluation, trial and adoption, our program has been given many means of expression. The use of some 300 colored slides representing weeds, the problems and control measures; the use of working models representing the weed seed screens recommended for cleaning waterborne weed seed from irrigation water; the use of a regularly scheduled radio program, always given on current weed control problems; the use of cooperative publications and of a flair for the printed word; the use of some 350 individual farm visits during the first year of the program; the loaning of spray equipment to farmers and in some cases giving them their first supply of the needed chemical; the use of every opportunity to speak on any phase of weed control to any type of organization, be it garden club or State experiment station; the use of some 75 demonstration plots, demonstrating the effectiveness of different chemical and cultural methods on farms and adjacent to county roads; the building of interest in weed identification and control among 4–H boys and girls; the use of live, potted specimens for fair displays along with pictures that tell the story of weed control. These and many other methods of obtaining and holding the interest of the people have been and are being used.

WEED SEED SCREEN—Del Suggs, Reclamation weed specialist, inspecting screen adapted by Ed Kerr, Quincy, Wash., farmer. ***Photo courtesy of author.***

Left to right: Oscar Schorzman, farmer-director, Quincy weed district; Ben Roché; Bob Johnson, settlers assistant county agent, Quincy, Wash.; Ralph Plank and Elmer Gerken, farmer-directors, Quincy weed district. ***Photo courtesy of author.***

The formation of community-sized weed districts seemed the best place to begin organizing. General education work would be continuous while weed district formation would be emphasized in those areas having expressed a desire for a control district.

The Quincy district, an area including some 60,000 acres of irrigable land, had been hampered in its early stages of formation by the growth rate of the community. Men who were natural leaders were spread so thinly over a series of community development projects that the proposed weed district was being neglected, unintentionally. The committee was called together and the petitions were tabulated. The number of acres needed to fulfill the required 51 percent was assigned to the members of the committee. Another year went by without obtaining the required signatures for the acreage. Weed control and the desirability of a weed district was discussed before all groups that expressed an interest. Articles from the Extension Office were given to the local newspapers regularly. The enthusiasm of the reorganized weed district committee was beginning to wane when a field planted to mint roots came up to a fine stand of Perennial Sow Thistle. The location of this 60–acre field of Sow Thistle was in the center of the most valuable farmland in the community. Farmers experienced in other sections of the country, particularly the Midwest, now recognized the need for a weed district. Signed petitions were submitted and a hearing was requested. A bouquet

LARRY REEKER, Ephrata, Wash., 4–H boy, wins top spot in State weed identification contest two consecutive years. ***Photo courtesy of author.***

of Perennial Sow Thistle was presented to the county Commissioners at the hearing. Grant County Weed District No. 1, the Quincy District, was created in the fall of 1955, too late to provide a feasible budget for the forthcoming year. Law thereby prevented actual operation in 1956. No funds, but a year to prepare their first budget and to ground themselves prior to issuing their first required policy statement.

The farmers of the Moses Lake area, upon hearing of the success in the Quincy area, requested a weed meeting. The committee that had been appointed 2 years before and men that had been working around the edges for several years combined forces. Committeemen contacted previous acquaintances from other irrigated areas. Committeemen with organizational or fraternal affiliations used these as a means of contacting landowners. Members of the soil-conservation district offered their land ownership lists and their office as committee headquarters. Within 3 months the petitions were signed and a hearing was called. In February 1956, Grant County Weed District No. 2, containing approximately 48,000 acres, was formed. The new officers of the Moses Lake District thus had until fall to become organized, prepare a budget, and prepare a district policy for the year 1957.

The countywide educational program has been continuous during the formation of districts 1 and 2. Other areas are contemplating district formation and their participation as organized districts is very much to be desired in the overall, long-time program. Emotions played a part in the Quincy area, friendly competition was basic in the Moses Lake movement, but these factors were in addition to the definite stages of acceptance which had readied these people for organized weed control. Various backgrounds of the people may tend to combine two or more of these stages, enabling individuals to take them all in one step; the majority will be slower however. A countywide weed program, in district form, is practical and desirable. We believe that we can obtain that goal and carry the people with us in a period of ten years. The present trend in agriculture, that of reduced labor per unit, of output and increased acreage under one managership, should make organized weed control easier to sell than it has been during the past three decades. # # #

GRAND COULEE IN COLOR

Illumination in color of the waterfall plunging over Grand Coulee Dam will begin late this summer following completion of a $150,000 light installation program authorized by Congress.

The spillway will be illuminated at the rate of 3.4 foot-candles. By comparison, the moon provides an illumination of one-tenth of one foot-candle.

The spillway will have a color program involving a 20-minute operation, automatically timed, during which colors will change repeatedly. Basic colors are white, amber, red, blue, and green.

The lighting of the falls a third of a mile wide and as high as a 30-story building, has aroused tremendous interest in the lighting industry, General Electric reported that it has "stirred more interest in the illumination field than anything else that has occurred in the last 15 years." Retired specialists were brought back to work by the company to work on the specifications. A major difficulty that had to be resolved was to manufacture nonfade glass for the various colors.

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If you have friends or associates who would be interested in the Reclamation Era, please send their names and addresses to the Bureau of Reclamation, Washington 25, D. C. We shall be glad to send them copies of back issues.

What's New In Beet Seed Development

by C. E. CORMANY, Chief Agronomist
Holly Sugar Corp.
Colorado Springs, Colo.

Spectacular things are occurring in the breeding of new varieties of sugar beets. True hybrid varieties and the long awaited monogerm type of seed are here. Hybrid sugar beets are producing 5 to 15 percent more sugar per acre than old standard varieties.

As the plant breeders progress in their research, the increases will be even greater. These hybrids are more disease resistant, sweeter and higher yielding than regular sugar beets.

By the use of inbreds, each with special merits, the combinations and recombinations may result in fantastic improvements in the yielding ability of the crop. Such was the case with corn, and it gave new life to Corn Belt agriculture.

The word "hybrid" implies greater vigor and bigger yields than either parent and therefore more profit per acre. Hybrid vigor and these other desirable features are now available for sugar beets.

True hybrids in the sugar beet plant were hard to get. Each sugar beet flower heretofore has borne both the male and female parts, causing self-pollination, and it was not until a U. S. Department of Agriculture scientist, Dr. F. V. Owen, discovered male sterility in the flowers of some sugar beet plants that hybridization became practicable. This meant that these plants produced no pollen themselves, and any seed produced on them had to be pollinized from other plants. The resulting seed was a true hybrid.

The complicated technique of securing this male sterile phase of a variety has been systematized so that the plant breeders can now develop a "male sterile equivalent" of almost any variety. These male sterile equivalents are then used as the female parent for hybridizing.

The possibilities for many and varied combinations provide a new and promising field of research. With this method varieties resistant to

MODERN GREENHOUSES in use in many locations are a valuable aid in speeding the plant breeders' work with hybrids and monogerm varieties. *All photos in this article courtesy of the author.*

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SUGAR BEETS of the third backcross in the development of a monogerm variety for commercial use. The greenhouse each winter saves a year's time in the development cycle.

two diseases can be developed by using the male sterile female of one and the pollen plant of the other parent.

Actual combinations of leaf spot and curly top resistance, of root rot and leaf spot resistance, and even combinations of all three have been made. Many other combinations are in the making now.

True hybrids for commercial use can be made by planting companion variety strips in a seed beet field—one strip, the larger, being the female (male sterile) parent and the other strip, the smaller, being the pollinator or male parent. The seed produced on the female strip is the hybrid, and the seed borne on the male parent is discarded.

Of great importance at this time is the development of monogerm sugar beet seed. The seed of the regular multigerm sugar beet is really a seed cluster containing from 1 to 5 true seeds, all of which usually germinate and form a thick mass of closely associated seedlings. Picture what an improvement it will be when each seed ball contains but one true seed, such as corn, beans, wheat and other crops.

Monogerm means "single germ." This type of seed is being developed now for commercial varieties of sugar beets for all areas.. The monogerm "gene" was found in 1948 in a sugar beet seed field in Oregon by a "displaced" Russian sugar beet scientist, Dr. V. F. Savitsky, employed by the Beet Sugar Development Foundation. (*This organization includes all the beet sugar companies of America, and its function is to coordinate scientific research and education as related to sugar beets. Headquarters is at Fort Collins, Colo.*) He increased the progeny from the two monogerm plants he had found.

Mother roots of these were distributed to the plant breeders of the various sugar companies and others. These research specialists are now introducing this monogerm character into their best present day varieties, largely by the backcross method. In a few years probably all sugar beet seed will be of the monogerm type.

Monogerm seed will have larger embryo sizes containing a much greater reserve of starchy plant food in each seed than our present varieties. It will be planted at a lower rate per acre (fewer seeds per foot of row) and possibly a trifle deeper into better soil moisture conditions, with a resulting seedling stand ideally distributed within the row.

Monogerm seed will encourage complete spring mechanization of the crop, eliminating the need of hand labor for thinning and, with the proper use of chemicals for controlling weeds, should add to the efficiency of sugar beet production.

Another comparatively new and interesting phase of sugar beet research is the development

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TYPICAL BEET SEED field near Phoenix, Ariz. Ten varieties of hybrids are being grown in the area for experimental work.

Compressed Air vs. Drought

Bubbles released at lower reservoir levels would bring cool water to the surface and markedly reduce evaporation

by ABRAHAM STREIFF

DR. ELWOOD MEAD (Deceased)
Commissioner of Reclamation—1924–36

Traveling Southwest in mid-summer from the lush green fields, cool pine woods and limpid lakes of Maine, vistas of verdure soon commence to spread out into Midwest farm flatlands already flecked with yellow, stubbled harvest fields and browning, sunburnt grass areas. Still farther along in the dry belt arid perspectives loom and pass and dust clouds, wind-blown from sandbars green-fringed only where water reaches thirsty roots, trail over hidden distant rivers.

The "expanding and contracting desert," as Isaiah Bowman referred to the climatic pendulum, once more swirls dust over vast reaches from Texas to Wyoming. For thousands of years man has dwelt, seemingly by preference, in regions of dwindling rains; indeed, civilization was born where rains begin to tarry and turn back. The Near East deserts are inexhaustible ruin histories of once thickly settled, irrigated empires that rose and fell in a bewildering succession from one millennium to the next. For 6,000 years irrigated realms have driven the desert hard to its sovereign haunts. The sagebrush-covered open spaces of dry plain and rock-strewn wasteland in the United States still remain and were marked the "Great American Desert" on old maps of the West.

Though much has been accomplished through modern engineering efforts, we still waste too much of that most precious of all elements—water. Half a century ago, Maj. Sir Hanbury Brown wrote about Indian irrigation: "If all the works conceivable are constructed in the Punjab and the Sind, 60 percent of the surface flow would still escape by the rivers to the sea." Fifty years later Prof. O. W. Israelsen stated in a book on irrigation that less than one-third of the water diverted for irrigation is consumed by growing crops. Waste of water continues unabated.

In U. S. Geological Survey Circular 229 (1952), the former Commissioner of Reclamation, M. W. Straus, said: "Lake Mead is the key reservoir for the distribution of Colorado River water to Arizona and portions of Nevada, Utah, and New Mexico. Without water this area would almost be uninhabited, and the bulk of the supply comes from the lower Colorado. Every drop is precious; the demand far exceeds the supply. For this reason the Bureau of Reclamation is obli-

Editor's Note: The Department of the Interior and the Bureau of Reclamation are greatly interested in evaporation problems and the Bureau is taking the lead in an investigation of mono-molecular films as an evaporation suppressor. There are other methods of suppressing evaporation that undoubtedly would bear investigation. This article explains one approach to the problem. The problem is so important that any reasonable proposal should be investigated. The author of this article, Mr. Abraham Steiff, is a consulting engineer of Quebec, Canada.

Reprinted from Compressed Air Magazine, August 1955.

HOOVER DAM in the Black Canyon of the Colorado River, Arizona-Nevada, with Lake Mead in background.

gated to remove every possible source of error in its handling of the water of Lake Mead. The evaporation loss cannot be prevented, but accurate knowledge of evaporation permits more efficient use of the remaining water."

Loss through evaporation is stupendous. According to the report of river control work and investigations, Lower Colorado River Basin, the annual evaporation measured by floating pans and corrected for rainfall is about 100 inches, or 8.35 feet. For the 120,000-acre surface area of Lake Mead this amounts to a million acre-feet per year. For all the reservoirs in the Southwest the combined loss is, indeed, serious. Fortunately, the actual recorded loss between inflow and outflow is much smaller, and the figure given is the maximum rate of evaporation during the hottest months of the year during which corrective measures as herein discussed, should be applied.

An editorial that appeared in the October 1948 issue of this magazine (Compressed Air Magazine) under the title *Precious Water* reviewed the situation clearly. As therein foreseen, the water problem has increased in scope. The value of 1 million acre-feet of water is emphasized by the fact that the 912-foot-high Grand Dixence Dam is being constructed in Switzerland in order to impound 40,000 acre-feet of water. Exceeding Hoover Dam in height (726 feet), it is being built to store only one twenty-fifth of the amount of water lost by evaporation in Lake Mead alone!

The late Commissioner of Reclamation Elwood Mead wrote in 1904 that "a California spring flowing 1 cubic foot per second recently sold for \$50,000." At that rate, and allowing for the devaluation of the dollar since then, the water lost through evaporation at the Hoover Dam Reservoir, which is equivalent to 1,382 cubic feet per second, might be valued at \$346 million today. Water for Texas rice culture costs some \$13 per acre-year, while that supplied by the Colorado aqueduct when constructed was estimated at \$18 per acre-foot.

The Government's saline-water program has

set a limit of 12 cents per 1,000 gallons, or $39 per acre-foot, for irrigation water. In the Neches Valley in Texas, located in the rain belt near the Louisiana border, the industrial water rate is already $50 per million gallons for quantities of 1 million a day, with a minimum monthly payment of $1,500. Near Corpus Christi it was 24 cents per 1,000 gallons, or $78 per acre-foot, 4 years ago.

Obviously, the price of water is climbing under the pressure of rapid depletion and insatiable demand. Decreasing the losses is equivalent to increasing the supply. If evaporation cannot be prevented it might possibly be reduced. Nature herself shows us on a vast scale how this might be brought about. For a solution let us travel to the shores of the Caspian Sea, which is about 730 miles long and 260 miles wide. This large body of water is all that remains of the great central sea which once extended from the Euxine (Black Sea) to the Polar Sea. As a result of this isolation, the Caspian loses more water through evaporation than its drainage basin supplies, and it is still falling. In 1890 it was more than 80 feet below the level of the Black Sea. At that time Elisee Reclus wrote: "If it were to rise to the original level, it would cover the surface of the steppes for several hundred thousand square miles and completely inundate the Volga River Valley below Saratov."

The Caspian is divided into three distinct parts which differ greatly from one another in depth and salinity. The northern section, a vast marsh, is nowhere more than 50 feet deep and has a salt

HOOVER DAM—The upstream face of the dam is an impressive background for the speedboat enthusiasts on Lake Mead. ***Photo by William S. Russell, Region 3.***

SECTION OF SOAP LAKE SIPHON, Columbia Basin Federal Reclamation project, State of Washington. ***Photo by H. E. Foss, Region 1.***

content of 0.0016. There the Terek, the Ural and especially the Volga River discharge so much fresh water into it that the sea provides water for drinking purposes. The deeper central basin extends to a spur of the Caucasus, and in the southern end, which is mostly surrounded by high mountains, soundings of 2,953 feet have been logged. In both these areas the average salinity is only 0.009, or one-half that of the Black Sea, which would seem to indicate a considerable decrease in the saltiness of the Caspian since its separation from that body of water. This is borne out by the shells of marine creatures found on the plains once covered by the Caspian and by shelfish of the same but smaller species now inhabiting the latter, for the size of the shells is proportional to the salt content of the water.

This decrease in salinity is explained by the fact that water evaporates at a different rate at different temperatures. As along the Gulf Coast of Texas, the waves of the Caspian throw up banks of sand in front of shallow bays along its shores, thus converting gulfs and creeks into lagoons. Sea water enters the latter through narrow channels, and because the water is not deep it is considerably warmer than that in the open sea. Evaporation is consequently greater, and sea water flows in to restore hydrostatic equilibrium. The lagoons therefore become depositories of salt. When storms or dry periods cause them to be isolated, the water rapidly evaporates and leaves layers of salt in them.

Reservoirs of this kind may be studied all along the circumference of the Caspian. A former bay

Pleasure boating on Lake Mead, Arizona-Nevada. Photo by William S. Russell, Region 3.

not far from Novo Petrosk is divided into a large number of basins, which present every degree of saline concentration. The same condition exists farther south near the Bay of Alexander and at the extreme end of the northern section in the sea arm of Karasu (black water). There the water is 0.057 part salt, exceeding in salinity the Gulf of Suez, the saltiest body of water.

On the east shore of the Caspian is the remarkable inland sea, rather than lagoon, called the Karaboghaz (black abyss). According to Reclus, a current from the open sea was always running into it through a narrow channel at a speed of 3 knots. The east winds retarded it and the west winds increased it, but it was never less than 1½ knots. Caspian seafarers and Turkoman nomads who inhabited its shores were impressed by the inexorable flow rolling over the shoals into the "black gulf," which none ventured to navigate because they believed it to be an abyss into the underworld.

Baer estimated that the Karaboghaz receives daily 350,000 tons of salt from the Caspian. Seals are no longer found there. A sounding line, when scarcely out of the water, is covered with saline crystals. Thus nature demonstrates that evaporation from cool water is less than from warm, and that water should be cooled to reduce evaporation. The next step is to find a cold medium that will serve to cool the surface waters. Actually, the reservoirs themselves can provide it, for they are virtually unused iceboxes.

The greater part of the Southwest has severe winters and hot summers. In the winter months the icy waters sink to the bottom; in the summertime warm water floats on top of the lower, colder layers. The density of the warmer water is from one- to three-thousandths less than the density of the colder strata. This is characteristic of all lakes in temperate regions and produces the familiar phenomenon of annual "turnover" in spring and fall. The deeper, colder layers demonstrate their presence in many ways. For instance, on the bathing beaches of Lake Michigan a rising east wind blows the water westward. When that happens, warning signs are posted and the up-welling icy water immediately causes the beaches to be deserted.

Unequal temperatures and densities bring about so-called density currents. The Office of River Control of the Bureau of Reclamation publishes annual reports containing graphs of the temperature, density and other factors in relation to the depth of Lake Mead. From these the following example is taken. On April 17, 1950, at Mile 334.9, where the water is approximately 400 feet deep, the temperature at the surface was 64° F.; 150 feet down it was 54°. Six months later the temperatures at the same levels were 84° and 58°, respectively.

Studies at Lake Hefner, Okla., have produced what is known as the Hefner formula. Applying this to certain average conditions it is found that evaporation would be:

0.057 inch per day at 55°
0.276 inch per day at 67°
0.415 inch per day at 80°

From this it may be seen that a drop of 13° reduces evaporation to two-thirds of the value at 80°.

Compressed air has long been used successfully to bring warm water from the bottom to the top for varying purposes even when the difference in temperature was small. To keep trash racks of hydroelectric stations ice-free, for example, air under pressure has been introduced through perforated pipes at the bottoms of intakes to make warmer water rise and thus prevent the formation of ice at the surface. This has been possible even in the case of shallow intakes. Similarly, air released from pipes lowered through holes cut in ice near frozen spillway gates effectually clears

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Dredging On The Colorado

Conservation of the Lower Colorado River's limited water supply is one of the major benefits of the Bureau of Reclamation's channelization program on the river in the vicinity of Needles, Calif.

Reclamation's 20-inch hydraulic suction dredge has been at work in the badly aggraded and meandering section of the river above and below Needles for the past 8 years, cutting new channel sections to restore the stream's flow to a defined channel. By realining the river, water formerly lost through evaporation and transpiration is being saved for much needed use by downstream farms and by cities and factories in the Pacific Southwest.

Channelization of the river above and below Needles was necessitated by the normal aggradation of the riverbed as aggravated by effects of the construction of large dams. The 11-mile stretch between Needles and Topock had so deteriorated that by 1944 it had spread out to form a swamp area several miles wide, where slow movement of the river allowed the deposition of silt on which grew willows, tamarisks, cattails, and other swamp vegetation. The dense growth increased the water surface elevation and promoted large water losses from evaporation and plant transpiration.

To remove the threat to Needles from a high-water table, which in the lower section of the city had risen above the ground, and, to avoid the danger of disastrous inundation should the flow of the river be increased by flood releases from Hoover Dam, Congress appropriated funds in 1944 for emergency measures. The Bureau of Reclamation hurriedly constructed protective works to provide temporary protection for the city and the Santa Fe Railroad which runs through the valley, and initiated investigations

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by PAUL A. OLIVER, Project Manager
Colorado River Front Work and Levee System
Bureau of Reclamation
Needles, Calif.

The Bureau of Reclamation's Columbia Basin project has enhanced the recreational values of the Columbia Basin area in the State of Washington. This region is fast becoming one of the Nation's most popular recreational developments. For your pleasure the following are offered:

SWIMMING
FISHING
BOATING
HUNTING
CAMPING
PICNICKING
LODGING

Recreation A

Columbia Basin

COMMITTEE OF NINE AND ADVISORY MEMBERS—1957: Standing: Frank O. Redfield, manager, Burley Irrigation District; Robert W. Ferebauer, manager, American Falls Reservoir District No. 2; David W. Dick, manager, Idaho Irrigation District; Merle L. Tiliery, superintendent, Minidoka project; Leo D. Murdock, director, Aberdeen-Supringfield Canal Co.; Clifford N. Scoresby, director, Progressive Irrigation District; Lawrence Duffin, Minidoka Irrigation District. Seated: Alex Coleman, secretary, Committee of Nine; Lynn Crandall, watermaster, Snake River District No. 36; N. V. Sharp, chairman, Committee of Nine; Leonard E. Graham, vice chairman, Committee of Nine; R. Willis Walker, director, Fremont-Madison Irrigation District; J. H. Silbaugh, president, North Side Canal Co. *(Photo by Melville's Studio, Idaho Falls, Idaho)* March 1957.

Upper Snake River's Committee of Nine

One of the West's most colorful and effective irrigation organizations is the Committee of Nine of Idaho's Upper Snake River Valley. Although essentially an advisory group dealing with distribution of the Snake River waters in the area from Bliss, Idaho, to the headwaters in Jackson Hole, Wyo., the group has gained State and National recognition in its efforts to promote Snake River irrigation through cooperation of State, Federal, and local interests.

The committee was first established in April 1919, and consisted of the following members: J. T. Fisher, Alfred Ricks, and J. R. Thompson, representing the North Fork Protective Association; Christian Anderson, P. J. Davis, and D. H. Blossom, representing the Farmers Protective Irrigation Association; and J. D. Wheelon, R. E. Shepherd, and Frank A. Banks, representing the Minidoka and Twin Falls projects. Watermaster John Empey was appointed chairman, and John Lee was the first secretary. The membership on the Committee of Nine was arranged to give representation by geographical areas, with three members representing the water users diverting water from the North Fork of the Snake River, three members representing users diverting water in the upper valley above Blackfoot, Idaho, and three members representing the users diverting water below Blackfoot.

The original purpose of the Committee of Nine was to assist the district 36 watermaster in solving the complex water distribution problems of the Upper Snake River. The advisory group proved so successful in developing solutions to the water-distribution problems, that it soon became recognized as the spokesman for all the irrigation interests in watermaster district No. 36, representing over 1 million acres of irrigated land. The influence of the group has steadily increased through the years until its advice and recommendations are sought by legislators and State of Idaho officials on such matters as water-

by JAMES F. DUMAS, Administrative Officer
Minidoka Project, Burley, Idaho

MINIDOKA PROJECT—Aerial view of North Side Pumping Division. *Photo by Phil Merritt, Region 1.*

right legislation for both surface and ground waters, on interstate river compacts, and on development of the State's water resources.

The Federal Government has for many years recognized the Committee of Nine as an unofficial advisory group to the Bureau of Reclamation in the development of the Upper Snake River Valley, and the project superintendent of the Minidoka project serves as an advisory member on the committee. The vast majority of the lands in district 36 are dependent to a large degree upon storage water furnished from Jackson Lake and Grassy Lake Reservoirs in Wyoming, and from Island Park and American Falls Reservoirs in Idaho. These reservoirs were constructed by the Bureau of Reclamation, and are operated by the Minidoka project. The costs of construction and the annual O. & M. costs are being repaid by the water users of district 36, and in line with the Bureau of Reclamation policy the water users are accorded a full voice in recommending operating procedure and reviewing the costs of operation and maintenance. This is one of the important assignments of the Committee of Nine. Representing over 50 canal companies and irrigation districts receiving water under separate contracts, this compact organization meets each year with Minidoka project officials to review and approve the reservoir operating budgets. It also makes an annual inspection tour of the reservoirs each year in behalf of the water users.

The Committee of Nine was officially recog-

JACKSON LAKE DAM, Moran, Wyo., *Photo by Phil Merritt, Region 1.*

AMERICAN FALLS DAM and spillway section, American Falls, Idaho.
Photo by Phil Merritt, Region 1.

nized by the Department of the Interior in the negotiation of contracts for sale of storage rights in the new Palisades Reservoir and remaining space in American Falls Reservoir. The group assisted the water allocations committee in determining the amount of space to be sold to each contractor, and negotiated directly with the Bureau of Reclamation in arranging for contract provisions relating to water savings, exchanges of water rights between Jackson Lake and American Falls Reservoirs, and the payment terms. The contracts as finally signed in 1952 specifically provide for approval of the Committee of Nine to adjustments in storage space allocations, for prior approval of winter releases of storage water for power generation, and consultation on all other matters of contract administration relating to water use.

As a nonpolitical organization interested solely in irrigation farming the Committee of Nine has gained considerable prestige through its unbiased support of reclamation projects such as the Palisades project, and the proposed Burns Creek regulating reservoir which was recently introduced in a bill before Congress. Its individual members are active in National Reclamation Association affairs, and national legislation and policies which affect farming and irrigation.

At a typical meeting in Burley, Idaho, on December 15, 1956, the Committee of Nine considered problems concerning water rights of the Bureau of Reclamation's Michaud Flats project, and the Bureau of Indian Affairs' Michaud Division of the Fort Hall project. It reviewed and approved the amount of water flows to be maintained for power generation at Minidoka Dam, and the payment to be made to the Minidoka power system for curtailment of production during 1956. The committee discussed and approved the 1957 operating budget for Bureau of Reclamation reservoirs, and received a report on snow surveys in the watershed areas. Regional Director H. T. Nelson of the Bureau of Reclamation reported on the progress of the Palisades project construction, and discussed the proposed Burns Creek regulating reservoir. Other items

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Teamwork At Alamogordo

by RUSSELL B. LEDYARD
Assistant Regional Engineer
Region 5, Amarillo, Tex.

Skin divers and unusual construction methods were resorted to by the contractor in placing the concrete tunnel plug in the trashrack of Alamogordo Dam under his recent contract with the Bureau of Reclamation. This work, completed in November 1956, consummated nearly 8 years of awaiting satisfactory water conditions and perfecting plans to save as much water as possible for the Carlsbad project water users and the fishing interests. Complete cooperation of local interests, the New Mexico Fish and Wildlife Commission, the Carlsbad Irrigation District, and the contractor with the Bureau of Reclamation made this possible. The work, although extremely hazardous, was accomplished quickly through the efficiency of the contractor.

The Alamogordo Dam on the Pecos River, 14 miles north of Fort Sumner, N. Mex., was completed by the Bureau of Reclamation in September 1937 to furnish storage for the Carlsbad Irrigation District. Diversion of the river during construction was through the outlet tunnel which was to be closed when the dam was completed. The concrete closure plug was never placed because of the need to store as much water as possible for the next irrigation season, and the desirability of water in Alamogordo Reservoir to facilitate necessary repairs on McMillan Dam, located downstream, during the winter months of 1937. Instead of placing the tunnel plug, closure was made by installing a "temporary" steel bulkhead gate in the 10-foot diameter tunnel, which in 1956 was under 50 feet of reservoir silt.

The danger of postponing replacement of the temporary steel bulkhead gate became accelerated each year because if it should rust out sufficiently to cause failure of the gate, serious damage and possible loss of operative control of the dam could result. Over the years the water elevation in the reservoir was never low enough to perform this work, and no one desired to release the small storage, especially in an area where every drop of water was needed. The Southwest has been in a drought for the last few years and the water of the Pecos River is vital to all in the Pecos Valley.

In August 1954, conditions appeared favorable to perform this work. Specifications were issued, bids requested, and one bid, in the amount of $21,330, was received. However, before award could be made and the reservoir lowered to permit access to the trashrack structure, rains over

At left: Trashrack structure at Alamogordo Dam during original construction in 1937. Above: Shows method of bulkheading off flow through trashrack.

the Pecos watershed raised the water surface and the work was indefinitely postponed.

Two years later in October 1956 conditions again appeared favorable and new specifications were issued for the job. Eight bids were received on October 30, 1956. The low bid of $12,579, by Miller, Smith & O'Hara, Inc., of Albuquerque, N. Mex., was accepted. Award and notice to proceed were issued on November 1 by Robert W. Jennings, regional director of region 5.

The work involved several problems of emergency action and full cooperation from the Carlsbad Irrigation District, the New Mexico Fish and Game Commission, local fishermen, residents of Fort Sumner, and the contractor. The trashrack structure and inlet tunnel are located about 300 feet upstream from the crest of the dam, in the reservoir area. The concrete plug was then located 68 feet down at the bottom of the structure. Original plans were to perform the work with an empty reservoir since the silt had built up to the entrance of the outlet structure. Draining the reservoir, however, meant a loss of water and fish, and a decision was reached to leave about 8 feet of water for saving the fish, and a change order was issued to cover the new contract requirements. The New Mexico Fish and Game Commission, aided by local fishermen and citizenry, moved to the dam site to spread a protective screen around the outlet structure to salvage or prevent the fish from going downstream. The contractor cooperated. Releases were started on November 5 and completed on November 7. The water was maintained at this low elevation through November 12, and then allowed to build up in the reservoir. The contractor was required to move in immediately, complete the job, and get out before the water inundated his work.

He ran into unexpected trouble in placing the stop logs and in sealing out the water of the trashrack structure. He hired six skin divers from the Lubbock (Tex.) Skin Divers Club to assist in cleaning out the debris around the trashrack and in placing and forming a seal around the stop logs of the trashracks in the murky water. These skindivers repeatedly dived into the dark silt-laden water. Working in the water during November, at an elevation of 4,200 feet, was a cold, laborious job, but these amateur skin divers demonstrated their ability to perform this unusual task. A practically watertight seal was accomplished to allow the contractor's employees to work in safety while pouring concrete almost 50 feet directly below in the outlet tunnel.

By November 14 at 8 a. m., final operations were started. Concrete equipment was set up on the upstream slope of the right abutment of the dam and was conveyed by a chute to a bucket on one of two barges forming a bridge from shore to the trashrack structure. The concrete was carried from the bucket at the end of the chute to the trashrack structure and then by use of a tremie tube with a funnel-shaped upper end, the concrete was fed vertically down through the

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Key Contract Awarded

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1 million persons by 1975 through construction of the initially authorized features of the Colorado River storage project and the participating projects indicates the very great magnitude of the benefits which will result in the short span of less than 20 years.

Expansion of irrigation water supplies will result in the long-range permanent chain of direct and indirect benefits which always attend irrigation developments in the arid West. The storage dams at tributary, upstream locations and the distribution canal and lateral systems on the participating projects will supply irrigation water to about 130,000 acres of new land and will provide supplemental water to about 230,000 acres of lands short of water late in each irrigation season. The total dollar benefits from these currently authorized irrigation projects will exceed $10 million annually.

About 25 additional potential participating projects are scheduled for priority investigation in the authorizing legislation. These would provide irrigation water for nearly 1 million acres of land, of which almost one-half would be new land and the balance presently irrigated farm land needing a supplemental water supply.

Control and use of water for municipal supply is also an important aspect of the upper Colorado River development program. Water for the anticipated rapid urban growth in the upper basin States is a critical need which will be met.

Water and power are ingredients essential to those industries which will be established to develop the tremendous, but now largely dormant, mineral resources in the upper basin States.

Steel ribbing being lowered 700 feet to bottom of canyon for use in right diversion tunnel. ***Photo by F. S. Finch, Region 4.***

Hoist entrance to exploration tunnel on left canyon wall.
Photo by F. S. Finch, Region 4.

The largely undeveloped mineral reserves of the upper basin States await development and use to meet the increasing national needs for domestic and defense materials. These reserves include large quantities of coal and petroleum; the principal United States sources of uranium, vanadium, and molybedenum; three-fourths of the Nation's phosphate ores; the world's greatest source of rare hydrocarbons; and much of the United States supply of gold, silver, lead, zinc, manganese, copper, bismuth, antimony, and magnesium. The mineral reserves of the central and eastern United States are being rapidly depleted, and the Nation will look to the mineral storehouse of the Upper Colorado River Basin to meet many future requirements.

Shale oil offers great reserves as yet untouched. It is estimated that a reserve 1,000 billion barrels of petroleum are available in the oil shales in the 16,500 square-mile area in the upper basin where Colorado, Utah, and Wyoming meet.

Phosphate materials—1.6 billion tons or three-fourths of the United States reserves—occur in the upper basin States, and await power as the foundation stone for a new industrial development.

Recreation is one additional important benefit of the upper basin development which needs to be mentioned. Hoover Dam and Lake Mead, visited by more than 2 million persons each year, offer evidence of the recreational values which result.

The 186-mile long Glen Canyon Reservoir will

open up the beauties of a canyon seen at present only by a mere handful of people each year.

The Colorado River storage project and the participating projects, with Glen Canyon Dam as the key structure, is a long-range undertaking. Widespread national, as well as regional and local, benefits will result. New employment opportunities will be created. Enlarged purchasing power will develop for manufactured goods produced throughout the Nation. The broadened tax base will increase the direct taxes paid to the Federal Treasury which in a short time will exceed the construction investment. With award of the prime contract on Glen Canyon Dam on April 29, 1957, the basinwide development program has begun.

Commissioner of Reclamation W. A. Dexheimer has summarized the importance of the basinwide development of the Upper Colorado River as follows:

"These things can be done at reasonable cost and are good investments whether done by local people, the States, or the Federal Government. The returns in stable, prosperous farms and communities; the returns in business and industrial activity; and the returns in local, State, and Federal taxes will more than pay the cost of Upper Colorado River development in a very short period of years. In addition, we will have opportunities for recreation so vitally needed for our enjoyment of better living and particularly needed to accommodate a growing population with more leisure time, paid vacations, and early retirement.

"Whether you view the water conservation and development features of this program as farmers, industrialists, retailers, or just plain vacationers, I think you will find they are very worthwhile."

# # #

WOMEN VOLUNTEERS WANTED FOR ERA

The Secretary or some other officer of each and every organization of women on our projects is requested to take her pen or typewriter in hand and write to J. J. McCarthy, Editor of RECLAMATION ERA, *and outline her views as to how the* ERA *may best serve the interests of our project women. The same invitation is extended to every woman not connected with a women's organization.*

Compressed Air vs. Drought

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away the obstruction in 1 day's time. This procedure is followed by waterpower plants on the Ausable River in Michigan where the winters are severe. In much the same way sawmills in the North Country keeps channels open in their millponds so logs can be floated to the mills the year round.

To reduce loss of water through evaporation, this procedure might be used in reverse. The Lake Hefner experiments revealed that during a 483-day period condensation rather than evaporation occurred on 56 days. The large unused volume of cold water in the lower levels of the Hoover Dam basin could be raised at least in part by means of compressed air and mixed with the surface water to lower the temperature and thereby lessen evaporation. To apply this method to a reservoir like Lake Mead would be a big job, but preliminary analyses of the complicated problems involved seem to indicate that it is feasible.

The author has conducted experiments in Texas and made many calculations as to what could be done by the use of specially equipped motorboats—floating versions of truck-mounted compressors. These could cruise around in the early morning when the water is coolest at the surface and could cover a great area in a short time. Considering that little power is required merely to circulate, not lift, the water in a lake (the difference in density is only 1/1000 part or so), the idea is not nearly so impracticable as it might appear at first hand.

Large losses demand extensive corrective measures—a routine matter in this day of huge projects. Research is needed, of course, to gather exact data. There is no difficulty involved in making measurements of evaporation by means of pans floating on the surface in areas where a compressed-air line has been lowered, and the comparative efficiency of stationary and mobile installations could easily be studied. The experiments would cost relatively little and should be undertaken because the time is not far off when the West, especially, will have to conserve every acre-foot of water if it is to remain productive. The iceboxes are there. Why not make use of them through the simple medium of bubbles of air?

# # #

PALISADES DAM AND POWERPLANT NEARS COMPLETION. This multiple-purpose dam will provide flood control, irrigation storage, and power for the Upper Snake River Area. *Photo by Norm Clayton, Region 1.*

Upper Snake River's Committee of Nine

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considered were a proposal to seek a court decree on new floodwater rights for various Snake River canals, and possible sale of additional American Falls and Palisades storage space to the Minidoka Irrigation District.

Members of the committee are elected each year at the time of the annual watermaster district No. 36 meeting. All canal companies and irrigation districts are represented by their officers and directors at that meeting, and the representatives from each of the three geographical areas meet separately to elect their Committee of Nine members for the ensuing year. The membership for 1956 consisted of N. V. Sharp, chairman, and Alex Coleman, secretary (each of whom has held his position since 1949), and members J. H. Silbaugh, Clifford Scoresby, R. W. Walker, Leonard Graham, D. W. Dick, Leo Murdock, and Frank Redfield. Advisory members of the Committee of Nine were Lawrence Duffin from the Minidoka Irrigation District, E. G. Gooding of the American Falls Reservoir District No. 2, and Merle L. Tillery, superintendent of the Minidoka project. Lynn Crandall, who is now serving his 28th consecutive year as watermaster of district No. 36, also attends each meeting in his official capacity as watermaster.

Meetings of the Committee of Nine are open to the public, and individual water users, irrigation organizations, municipalities, and State or Federal bodies are invited to participate in the discussions and present any proposals for consideration by the group. Attendance at the meetings often runs from 50 to 100 or more, depending upon the subject to be discussed. In this manner, the Committee of Nine has become firmly entrenched as a leading advocate, and through its use, as an outstanding example between local interests and State and Federal Governments.

In recognition of its achievements in the fields of conservation and irrigation, the Department of the Interior's Conservation Award was presented to the Committee of Nine at its meeting in Idaho Falls, Idaho, in March, 1957. Regional Director H. T. Nelson of the Bureau of Reclamation, Boise, Idaho, made the presentation for the Department. In his letter presenting the award to the committee, Secretary of the Interior Fred A. Seaton said:

"It is a pleasure to grant the Committee of Nine the Conservation Service Award of the Department of the Interior in recognition of outstanding work since its inception in 1919 in aiding the overall development of land and water resources of the Snake River Basin.

"Representing the various water users' groups in the Snake River Valley, the committee has brought about a beneficial and effective program of resource development. Throughout the years its broad experience and fair consideration of all viewpoints have made it the focal point of discussions on resource development programs in the upper Snake River area and have also increased public appreciation of the many difficult and complex problems involved in land and water resource development.

"The enclosed Conservation Service Award certificate carries with it the appreciation of the Department of the unselfish public service which your committee has rendered and is continuing to provide. # # #

IDEAS WANTED

Have you a good idea on a short cut or labor-saving device to share with other water users on Reclamation projects? Send it in to the Editor, *Reclamation Era*, Bureau of Reclamation, Washington 25, D. C. The writing does not have to be fancy. Just make certain you have the answers to Who, What, Where, When, Why, and How in your story. As for pictures, a rough sketch or snapshot would serve the purposes.

First water delivery ceremony, Kennewick Division, Yakima Project, Wash., April 26, 1957. Left to right: Floyd E. Dominy, Chief, Division of Irrigation, Washington, D. C.; United States Senators Warren G. Magnuson and Henry M. Jackson; Walter Crayne, Kennewick Irrigation District Board; Orvel L. Terril, Kennewick Irrigation District Board chairman; W. A. Sloan, Kennewick Irrigation District Board; Van Nutley, Kennewick Irrigation District manager; E. J. Brand, Kennewick Irrigation District manager (retired); O. W. Lindgren, superintendent, Yakima project; Don A. Creswell, president, Franklin County Irrigation District; H. T. Nelson, regional director, Boise, Idaho; W. L. Karrer, construction engineer, Kennewick Division.

The Editor's Column

The following facts have been gleaned from the United States Department of Agriculture's "Agricultural Situation," dated May 1957. We hope that you find them helpful.

Total farm output in 1957 is likely to be down for the first time in 7 years. United States demand for farm products should continue strong since consumer income is expected to stay higher than a year earlier. Export demand also is strong with farm products moving to foreign markets at a record rate.

Some reduction in supply and good demand should hold farmers' prices a little above the 1956 level, through 1957. Livestock prices probably will average above those of 1956; crop prices, lower. Supports for cotton, major feed grains, and oilseeds are lower than in 1956. Supports for most other products are about the same.

Feed Grains

Large supplies of feed grains are again likely in 1957–58, though they may be a little under this year's record. Prospective acreage is slightly larger, but large cuts in high-yielding corn and oats may hold down production.

Average yields on the prospective acreage would result in a production of about 119 million tons, 10 million less than in 1956. But carryover into 1957–58 will be up about 7 million tons. Large supplies of high protein feeds are also in prospect, at least as large as in the current season.

Cotton

Shipments of cotton abroad continue heavy, building a total this season which may top 7 million bales. Exports in the season ending in June 1956 were 2.2 million bales. Total use (including exports) is expected to be about 15.8 million bales, up 4.4 million bales from the preceding season.

The increase is entirely due to higher exports since domestic use is running below the previous season. A reduction in stocks by about 2.5 million bales is expected on August 1, 1957.

Teamwork at Alamogordo

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trashrack structure for a distance of approximately 50 feet. More than usual care had to be taken in this operation to avoid segregation of the concrete. It took 15 hours to place the concrete.

Men and equipment worked continuously for 36 hours in the final phases of the work. Six hours were required to clean the tunnel, 12 hours for placing forms and steel, 15 hours for placing concrete and 3 hours of clean-up. Coordination of operations was the keynote in the contractor's efficient organization.

When the work was completed and accepted by the Government on November 17, 1956, 17 days after award of the contract, the cost was well below the allocation. The local people were well satisfied with the Bureau's job of saving the fish and salvaging water in this drought stricken area, and safety of the operative control of the dam was assured.

The work was under the direct supervision of Bert Levine, acting construction engineer, and two inspectors, Allen W. Kendrick and Carl J. Lethgo. # # #

Dredging on the Colorado

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to find a permanent solution to the problem. Reclamation engineers concluded that only by establishing a new river channel at certain points along the river in that area could the river again be confined to a definite course to reduce the flood danger and lower the high-water table. The 20-inch hydraulic suction dredge was constructed and placed in operation to carry out this plan which to date has been very successful. The water in the river at Needles has dropped several feet since completion of the Needles-Topock dredged channel.

The dredge's most recent achievement is a 1.9 mile-long channel out 5 miles north of Needles through which the Colorado River now is flowing. This new channel bypasses the streamflow around a badly aggraded and meandering stretch of the old riverbed.

The dredge recently cut through to the river from the 1.9-mile channel which has been under construction since last August 16. At the time of the breakthrough, the water surface in the river was 3 feet higher than that in the dredged channel. A short time after the river entered the new channel, the water in the dredged channel had risen to the level of that in the river and flow in the new channel had been established.

Named after the river in which it was first launched early in 1949, the huge dredge is extending the channelization work upstream. In cutting the 1.9-mile section, the dredge was headed upstream on a predetermined alinement roughly paralleling the old riverbed. At a point some 8,500 feet upstream from the lower end of the dredged channel where the bank separating the new channel from the river narrowed to only a few feet, the dredge cut through to the river to permit a flow at that time of some 5,000 cubic feet per second to enter the new route.

As the dredge's cutter head chewed away at the earth barrier separating the new and existing channels, its pump forced the earth and other dredged material through an 1,800-foot pipeline to the far river bank where it was discharged to form the channel levee. As the dredge cuts new channels to straighten out, deepen, and realine the river, such dikes are thrown across the old riverbed to isolate its abandoned sections and dry them up.

BUREAU'S DREDGE SHOWN IN NEW CHANNEL north of Needles, Calif. The dredge recently cut through to the Colorado River, pouring through opening in left center of picture into new channel. Dredged material was discharged at right to close old channel. ***Photo by R. C. Middleton, Region 3.***

This new section of channel on the river was dredged in widths varying from 180 feet to 360 feet, depending upon nature of materials excavated and levee material required, with the expectation that the summer flows of the river will widen the channel to the desired 450-foot width. The excavated depth varies from 15 feet to 23 feet and about 1,400,000 yards of material were dredged to complete the channel in this reach of the river.

The 1.9-mile channel is the third closed or "bobtail" cut to have been made by the dredge since it was placed in operation. The first was a portion of the 11-mile cut between Needles and Topock; the second, a 2.2-mile channel about 7 miles upstream from Needles. The dredge is scheduled to cut another 3½ miles of channel this year. Much of the work on the river this year upstream of Needles will be concerned with closing the gaps between the previously constructed sections of levee upstream from Needles.

Channelization and construction of other protective works along the silted and meandering stretches of the river will be a continuing major construction activity until maximum benefits in conservation of water for downstream water users and protection of the areas along the river from flood damage have been achieved.

# # #

Sugar Beet Development

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of polyploids. This is a complicated breeding system of changing the chromosome number in the plant by chemicals or otherwise. The resultant sugar beet plants are generally larger and may contain more sugar. The seed catalogues now list polyploids of several kinds of vegetables and flowers at fancy prices. The use of polyploids in sugar beets is being studied extensively and their characters may be incorporated into the hybrid monogerm sugar beet seed of the future.

Many other characteristics of the sugar beet are being studied with an eye to overall improvement. All new varieties, whether they be hybrids, monogerms, polyploids or inbreds, are tested for factors which affect quality. All breeding stock is subject to numerous detailed tests to determine the amount of sodium, potassium, raffinose, etc., which may aid or limit sucrose storage

Beet seed breeding plot showing seed plants with paper bags placed over the flowers. This technique is used in securing inbreds and hybrids.

in the beet root or be a hindrance in sugar recovery in the factories.

Sugar beet seed development is all directed toward varieties with greater efficiency in the production of the crop. Higher yields are necessary in sugar beets as well as in corn and other crops, if the grower is to realize the maximum return per acre for his crop. Mechanization of farming is here to stay. The harvesting of the sugar beet crop by machinery now is 100 percent in America, and full spring mechanization of the thinning operations is progressing rapidly.

The U. S. Department of Agriculture and several of the State agricultural experiment stations maintain staffs of highly specialized personnel doing extensive research of many kinds on sugar beets. Several of the sugar companies have large research departments with highly trained specialists—agronomists, plant breeders, plant pathologists, entomologists, chemists—who devote all their time to the betterment of the crop. The most modern laboratories, greenhouses, root cellars and specialized equipment are used .

With all this concerted effort toward sugar beet improvement, we can expect better varieties of sugar beets in the immediate future. ###

YOUR MAGAZINE

Are there particular types of articles which you would like to see in the ERA that we have not printed to date? If so, please let us know, and we shall do our best to comply with your wishes.

HOOVER SEWAGE PLANT IN OPERATION

Sewage from Hoover Dam and powerplant is now being treated before being discharged into the Colorado River.

The Bureau of Reclamation recently placed in operation its new treatment plant at the dam and powerplant to eliminate the possibility of river pollution from this world-famed structure.

The plant was built by Longley Construction Co., Inc., Las Vegas, Nev., under a $43,645 contract awarded last May. Funds were appropriated by Congress and the facility was programed for completion in fiscal year 1957.

The plant was designed by the Bureau of Reclamation, Office of the Commissioner and Chief Engineer, Denver, Colo., assisted by Consulting Engineer Richard R. Kennedy of San Francisco, noted authority on sewage disposal. It meets the requirements of the Departments of Health of the States of Arizona and Nevada, according to Boulder Canyon Project Manager L. J. Hudlow, who has supervision of the dam and powerplant.

Appropriation of funds for construction of the plant followed protests from fishermen and other sportsmen and domestic water users downstream who believed pollution from the dam and powerplant created health problems.

Statistics show that during a peak 4-hour period, 2,000 tourists visit the dam and powerplant. There are some 200 operating personnel in the dam and powerplant during an 8-hour shift, except on holidays and weekends when there is an average of 75. Nearly a half million tourists, besides the operating personnel, use the sewage facilities of the dam and powerplant each year.

The sewage discharged into the Colorado River averages less than 25 gallons per minute with an average flow of the river below Hoover Dam exceeding 5 million gallons per minute. However, the sewage treatment will eliminate any possible danger resulting from discharging sewage from the dam and powerplant into the river.

The sewage treatment plant at Hoover Dam, located in the lower penstock access tunnel on the Arizona side of the river, is a complete activated sludge unit, designed for a 32-gallon-per-minute average peak flow, operating with high efficiency so that the effluent, before discharge into the Colorado River below the dam is as follows:

1. Approximately 10 parts per million biochemical oxygen demand with positive oxidation, with a maximum of 25 p. p. m. BOD as an extreme.
2. Free chlorine residual and dissolved oxygen.
3. 10 p. p. m. suspended solids with 25 p. p. m. as an extreme maximum.

The effluent is disinfected with chlorine before being discharged into the river. The digested sludge is removed by tank truck.

During a 4-hour period of peak flow, 7,680 gallons of sewage will be treated. This sewage, which comes from the dam, powerplant, valve houses, and exhibit building, is collected by a pipe system in the dam and powerplant and is delivered to the sewage plant by pumps. # # #

A HALF CENTURY OF PROGRESS

The water users of the Klamath project, California-Oregon, celebrated 50 years of successful operation in May. Construction of the project was authorized in 1905 and the first delivery of irrigation water through the federally constructed facilities was made on May 16, 1907. In its first year of operation water deliveries were made to 8,900 acres. Today service is provided to about 200,000 fertile acres, much of which was once the submerged bed of Tule Lake.

Through the half century the Federal Government has invested about $14.7 million in construction. During this period the gross value of crops produced amounted to about $350 million. Federal tax revenues since 1940 have accumulated to total about $95 million. These and other revealing facts are presented in a short report prepared by the Bureau at the request of the Committee on Interior and Insular Affairs, House of Representatives. The report entitled "A Half Century of Progress on the Klamath Federal Reclamation Project" was published by the committee as "Committee Print No. 7."

"EACH YEAR over 1,000,000 acres of cultivable land is going into homesites, industrial establishments, highways, airports, and other nonagricultural uses."—D. A. Williams, Administrator, Soil Conservation Service.

MAJOR RECENT CONTRACT AWARDS

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DC-4728	Rogue River Basin, Oreg.	June 4	Construction of main canal structures, station 123+00 to 829+00, Medford and Rogue River Valley irrigation districts.	Ausland Construction Co., Grants Pass, Oreg.	$113,462
DC-4735	do	May 7	Construction of earthwork, pipelines, and structures for Yankee Creek siphon and Antelope Creek siphon and wasteway, Medford canal rehabilitation, Medford irrigation district.	Cherf Bros., Inc. and Sandkay Contractors, Inc., Ephrata, Wash.	181,270
DC-4816	Missouri River Basin, S. Dak.	May 21	Construction of stage 04 additions to Sioux Falls substation	Lindstrom Construction Co., Grand Forks, N. Dak.	149,997
DC-4818	Rogue River Basin, Oreg.	Apr. 3	Furnishing and installing one 16,842-kv.-a., 600-r.p.m., vertical-shaft generator for Green Springs powerplant.	Pacific Oerlikon Co., Tacoma, Wash.	283,668
DC-4825	Colorado River Storage, Ariz.-Utah.	Apr. 29	Construction of Glen Canyon Dam and powerplant	Merritt-Chapman and Scott Corp., New York, N. Y.	107,955,522
DC-4834	Missouri River Basin, Iowa.	Apr. 4	Construction of 161-kv. and 230-kv. additions to Sioux City substation.	Union Electric Co., Phoenix, Ariz.	194,777
DC-4844	Missouri River Basin, S. Dak.	Apr. 30	Constructing foundations and furnishing and erecting steel towers for 67 miles of Utica Junction-Sioux Falls 230-kv. transmission line.	Lipsett, Inc., Yankton, S. Dak.	1,316,411
DC-4845	Missouri River Basin, N. Dak.-Minn.	do	Constructing foundations and furnishing and erecting steel towers for 165 miles of Fargo-Granite Falls 230-kv. transmission line.	Lipsett, Inc., Yankton, S. Dak.	3,097,440
DS-4847	Missouri River Basin, S. Dak.	May 3	Three 5,000-kv.-a. spare mobile power transformers, each with a trailer transport, for Region 6.	General Electric Co., Denver, Colo.	148,293
DS-4850	do	May 6	Three 20,000/26,667/33,333-kv.-a. autotransformers for Sioux Falls substation.	American Elin Corp., New York, N. Y.	329,955
DS-4852	Missouri River Basin, Wyo.	Apr. 19	Construction of earthwork, structures, and surfacing for access road, Glendo Dam and reservoir, schedule 1.	Peter Kiewit Sons' Co., Sheridan, Wyo.	108,741
DC-4856	Columbia Basin, Wash.	Apr. 12	Furnishing and installing spillway flood-lighting system at Grand Coulee Dam, using colored lighting system, schedule 1.	Westcoast Electric Co. of Washington, Inc., Seattle, Wash.	150,010
DC-4858	Missouri River Basin, Mont.	do	Construction of Helena Valley Dam	Cherf Bros., Inc., and Sandkay Contractors, Inc., Ephrata, Wash.	357,606
DC-4859	do	May 14	Construction of earthwork and structures, except siphons, for Helena Valley canal, station 149+02.5 to 572+50, schedule 1.	Miles and Williams, Kennewick, Wash.	205,032
DC-4859	do	do	Construction of earthwork and structures for monolithic concrete siphons for Helena Valley canal, schedule 2.	A and B Construction Co., Helena, Mont.	312,160
DC-4864	Rathdrum Prairie, Idaho.	May 13	Construction of Hayden Lake pumping plant and furnishing and installing water distribution system, schedules 1 and 3.	Intermountain Co., Boise, Idaho.	340,527
DC-4865	Colorado River Storage, Ariz.-Utah.	do	Furnishing and erecting 150,000-gallon elevated steel water tank and 3,000,000-gallon steel storage reservoir for Glen Canyon community facilities, schedules 1 and 2.	Pittsburgh-Des Moines Steel Co., Santa Clara, Calif.	189,190
DS-4866	Central Valley, Calif.	May 7	Three 84-inch ring-follower gates with hydraulic hoist, hanger, gate position indicator, and one set of handling equipment for outlet works and auxiliary outlet works at Trinity Dam.	Hardie-Tynes Mfg. Co., Birmingham, Ala.	198,375
DC-4872	Michaud Flats, Idaho	do	Construction of earthwork and structures for Main Canal—East.	Cherf Brothers, Inc. and Sandkay Contractors, Inc., Ephrata, Wash.	581,569
DC-4874	Missouri River Basin, Nebr.-Kans.	May 10	Construction of earthwork and structures for Courtland West Canal, Station 0+00 to 517+42, and laterals, wasteway, and drains.	Bushman Construction Co., St. Joseph, Mo.	790,196
DC-4877	Rogue River Basin, Oreg.	May 27	Construction of earthwork, concrete canal lining, and structures for Howard Prairie delivery canal, station 0+09 to 539+00; and Soda Creek diversion dam and feeder canal.	Cherf Bros., Inc., Sandkay Constructors, Inc., and S. Birch & Sons Construction Co., Ephrata, Wash.	1,636,739
DC-4881	Solano, Calif.	June 7	Construction of earthwork, concrete canal lining, and structures for Putah South canal, station 1017+00 to 1476+25.52.	Marshall & Haas, Belmont, Calif.	1,186,826
DC-4884	Missouri River Basin, Kans.	June 13	Construction of Woodston Diversion Dam	Ace Construction Co. and M. and A. Construction Co., Omaha, Nebr.	541,957
DC-4887	Colorado River Storage, Ariz.-Utah.	May 28	Placing bituminous surfacing and constructing guardrail for 25 miles of access highway and construction of Manson Mesa airstrip, Glen Canyon Dam.	Alexander Construction Co., Inc., Minneapolis, Minn.	1,517,413
DC-4888	Columbia Basin, Wash.	June 25	Construction of earthwork and structures for WB5 wasteway No 1, Wahluke Branch canal laterals, block 20.	Arthur R. Sime, Kennewick, Wash.	321,157
DC-4890	Colorado-Big Thompson, Colo.	June 6	Construction of Big Thompson powerplant and switchyard	Davis & Butler Construction Co., Salt Lake City, Utah.	461,226
DC-4894	Cachuma, Calif.	June 19	Modifications of pressure reducing valve stations and meter stations of South Coast conduit, Goleta, Carpinteria, Montecito, and Summerland distribution systems.	J. E. Young Pipe Line Contractor, Inc., Los Angeles, Calif.	198,398
DS-4913	Commissioner's Office, Denver.	June 24	One alternating, current calculating board addition, including a device that is capable of maintaining the real power output (watts) of the unit at a predetermined value, for power systems studies.	Electronic Contractors, Portland, Oreg.	145,874
100S-281	Minidoka, Idaho	Apr. 12	Thirteen deep-well pumping units for wells, schedule 1	Layne & Bowler, Inc., Memphis, Tenn.	159,093
100S-282	do	Apr. 23	Motor control equipment for 40 deep-well pumping units, schedules 1 and 2.	Delta Switchboard Co., Stockton, Calif.	106,270
100S-284	do	do	Six 200-kv.-a., fifteen 150-kv.-a., eighteen 100-kv.-a., nine 75-kv.-a., fifteen 37½-kv.-a., and twenty-one 25-kv.-a., distribution transformers with lightning arresters for distribution substations for 40 wells.	R. E. Uptegraff Mfg., Scottdale, Pa.	126,221
100S-288	Snake River, Idaho	Apr. 25	Aerial photographs and topographic maps of 122,000 acres of Long Tom unit, second increment.	McIntire and Quiros, Inc., Los Angeles, Calif.	88,710
117C-429	Columbia Basin, Wash.	June 7	Furnishing and installing water service, drain, and sewer piping for residences in Mason addition at Coulee Dam, Wash.	Grant County Plumbing & Heating Co., Inc., Ephrata, Wash.	47,153
117C-432	do	May 31	Deepening 6.7 miles of DW240 wasteway, block 76	Utility Construction Co., Ontario, Oreg.	85,989
200C-350	Solano, Calif.	June 14	Furnishing and erecting 70 miles of right-of-way fencing around Lake Berryessa.	El Dorado Fence Co., Inc., Oakland, Calif.	244,759
400C-83	Colorado River Storage, Ariz.-Utah.	June 13	Construction of earthwork, structures, and surfacing for Arizona-Utah State line to Vista Point road and parking area, Glen Canyon Dam site.	W. W. Clyde & Co., Springville, Utah.	55,453
700C-435	Missouri River Basin, Nebr.	May 21	Construction of earthwork and structures for surface drains and repair of Walworth wasteway for Sargent canal.	Central Drainage and Construction Co., Sargent, Nebr.	93,993
701C-439	Missouri River Basin, Nebr.-Kans.	June 24	Construction of earthwork, concrete lining, and structures for Franklin drain 1-1-11; Franklin canal wasteway, station 2388+78.2; and additions and extensions to Franklin lateral system.	Platte Valley Construction Co., Grand Island, Nebr.	171,608

U. S. GOVERNMENT PRINTING OFFICE: 1957 O—430110

Construction and Material for Which Bids Will Be Requested Through September 1957[1]

Project	Description of work or material
Central Valley, Calif.	Constructing a 25-cfs-capacity, 2-unit, outdoor-type pumping plant.
Collbran, Colo	One 3-foot 6-inch by 3-foot 6-inch and two 2-foot 3-inch by 2-foot 3-inch, high-pressure gates, including hoists and transitions for Vega Dam. Total estimated weight: 50,000 pounds.
Colorado-Big Thompson, Colo.	One 4,160-volt switchgear assembly for the control of 4,500-kv.-a. generator for the Big Thompson Power-plant.
Colorado River Storage, Ariz.	Constructing the Page Government community. Work will include constructing about 200 three-bedroom residences with 1,150 to 1,200 square feet of floor space. The specifications may include an option for an additional 150 residential lots for private development. About 135 miles north of Flagstaff.
Do	Constructing a 360- by 144-foot steel-frame administration building, a 146- by 70-foot steel-frame fire station and garage, a 225- by 36-foot steel frame dormitory, and a 144- by 48-foot steel-frame police building.
Do	Constructing a river pumping plant, a chemical feed house, a high-lift pumping plant, about 12,000 feet of 10-inch steel and 12-inch steel, cast iron or asbestos cement pump discharge line, a filtration plant, and a wash water recovery pond, erecting 60-foot-diameter presedimentation and sedimentation tanks and installing pumps and motors, and furnishing and installing additional pumps, motors, control equipment and all appurtenant apparatus.
Colorado River Storage, N. Mex.	Constructing facilities for the 140-person Navajo Government community. Work will include constructing about 15 residences, furnishing and erecting a trailer washhouse, constructing a street, a sewage collection and disposal system, and a water supply and distribution system. About 39 miles east of Farmington.
Do	Constructing a 3-bedroom residence. About 39 miles east of Farmington.
Colorado River Storage, Utah.	Constructing a 105- by 36-foot wood-frame administration building, a 54- by 39-foot wood-frame laboratory, a 100- by 30-foot concrete masonry garage and fire station, and a 60- by 24-foot wood-frame conference hall. At the Flaming Gorge community, about 16 miles southeast of Linwood.
Do	Furnishing and erecting seven 5-car prefabricated metal garages. At the Flaming Gorge community.
Columbia Basin, Wash.	Constructing about 3 miles of 2-foot bottom width concrete-lined canal and 2 turnout structures. Wahluke Canal, south of Othello.
Do	Earthwork and structures for about 60 miles of laterals and wasteways, and constructing 8 minor relift pumping plants. Block 20, northwest of Mesa.
Do	Earthwork and structures for about 4 miles of concrete-lined laterals and 1 mile of wasteways. Block 401, near Moses Lake.
Do	Placing blended compacted earth lining in 4,950 feet of laterals. Blocks 86 and 87, about 18 miles northwest of Othello.
Do	Earthwork and structures for deepening 6.5 miles of open drains. Blocks 41 and 42, near Moses Lake.
Do	Deepening the DW239B and DW238C systems. Block 78, south of Quincy.
Do	Five motor-driven, horizontal, centrifugal-type pumping units. Radar pumping plant.
Deschutes, Oreg	Constructing a 1-story combination office, warehouse and shop building 38 feet wide by 61 feet long. At Madras.
Gila, Ariz	One 4,160-volt motor control switchgear assembly for control of 2,250-hp. synchronous motor for the Yuma-Mesa pumping plant.
Gulf Basins, Tex	Drive boring, sampling, and penetration resistance testing for the Toledo Bend Dam site on the Sabine River.
Middle Rio Grande, N. Mex.	Removing spoil piles along the settling channel· cleaning, rehabilitating and providing for power operation of the gates at Angostura Diversion Dam. North of Albuquerque.
Do	Rehabilitating Cochiti Diversion Dam on the Rio Grande, west of Santa Fe.
Do	Earthwork and structures for a 2,000-c. f. s. channel 9 miles long· and a 600-foot-long timber bridge. North of Socorro.
Do	Earthwork and structures for a 2,000-c. f. s. channel 1 mile long· a 265-c. f. s. canal 1 mile long· a 2,000-c. f. s. tunnel liner plate culvert under a raoiroad. Socorro area, about 14 miles north of Socorro.
Do	Clearing, cleaning, and shaping about 13 miles of laterals, wasteways, and acequias and constructing appurtenant structures.
Do	Earthwork and structures for a 2,000-c. f. s. channel 3 miles long. About 20 miles south of San Antonio.
Do	Clearing, cleaning, and shaping about 10.4 miles of laterals, removing structures and constructing new structures.
MRB, Colorado	Removing 25-kv. metering equipment and installing 69-kv. metering equipment and supporting steel structure. Muddy Pass, about 27 miles northwest of Kremmling.
MRB, Montana	Constructing about 23 miles of 16- to 6-foot bottom width canal and appurtenant structures. Helena Valley Canal, near Helena.
Do	Constructing about 6.3 miles of open drains. Helena Valley (north side), near Helena.
MRB, Nebraska	Constructing concrete headworks structure with two 10- by 16-foot radial gates; constructing earth dike 1,400 feet long with riprap protection; repairing existing diversion structure, installing two 14- by 9.5-foot radial gates and constructing a timber bridge. Culbertson Diversion Dam, near Palisade.
Do	Placing 75,000 cubic yards of sand embankment against the earth dike at the Milburn Diversion Dam and placing 300 cubic yards of 24-inch deep gravel blanket. About 20 miles northwest of Sargent.
Do	Earthwork and structures for 12 miles of unlined canals, wasteways, and drains. Near McCook.
Do	Earthwork and structures for about 10.5 miles of Meeker Extension Canal and 2 dikes about 40 feet high. Near McCook.
MRB, South Dakota.	Reconstructing and repairing Lateral 15.8. Near Oral.
Do	Applying about 40,000 square yards of bentonite lining to the Angostura Canal. Near Oral.
Do	Constructing additions for the Granite Falls Substation.
MRB, Wyoming	Two 25,263-kv.-a., 0.95 power factor, 11,500-volt, 257-r. p. m., vertical-shaft, hydraulic-driven, indoor-type, synchronous generators for the Fremont Canyon Power plant.
Do	Six 7,400/9,250-kv.-a., OA/FA, 11.2–115/66.4-kv., single-phase power transformers for the Fremont Canyon Powerplant.
Provo River, Utah.	Constructing 2,000 feet of 46-kv. transmission tie line, 1,400 feet of 2.4-kv. camp supply and signal communication lines, and 250 feet of 2.4-kv. aeration plant service line. At the Deer Creek Powerplant, about 16 miles northeast of Provo. (Readvertisement of Specifications No. 400C–81.)
Rogue River Basin, Oreg.	Constructing the Keene Creek Earth Dam and appurtenant structures, the Cascade Divide and Green Springs 6-foot-diameter tunnels, and the 60-inch-diameter, 8-inch shell thickness, monolithic concrete, precast concrete pipe or steel pipe Green Springs Pressure Conduit. About 16 miles southeast of Ashland.
Do	Constructing about 8 miles of Howard Prairie Delivery Canal, and the Little Beaver Creek earth and rockfill diversion dam and appurtenant structures. Near Ashland.
Do	Removing wood stave pipe siphon and constructing pipe siphon about 1,500 feet long. Near Medford.
Santa Maria, Calif.	Hydraulic controls for four 7- by 12-foot outlet gates for Vaquero Dam. Estimated weight: 12,000 pounds.
Shoshone, Wyo	Modifying the Buffalo Bill Dam to include a new outlet works. On the Shoshone River, west of Cody.
Do	Four 4- by 5-foot high-pressure gates. Estimated weight: 182,000 pounds. For Buffalo Bill Dam.
Solano, Calif	Constructing about 8.7 miles of concrete-lined canal. Putah South Canal, west of Fairfield.
Ventura River, Calif.	Constructing a 500-foot-long rock weir, a 60-foot-wide gated spillway, a 500-c. f. s.-capacity canal headworks, a Parshall flume, a concrete-lined canal 5.25 miles long, with culverts, drainage inlets and bridges, a 78-inch-diameter siphon, and a reinforced concrete chute-drop terminal structure into Casitas Reservoir. Robles Diversion Dam and Robles Casitas Diversion Canal, north of Ventura.
Do	Earthwork and structures for 25,800 feet and 141,700 feet of precast concrete pipe. Near Ventura.
Do	Furnishing and installing a complete automatic control and telemetering system for a municipal water district. Vicinity of Oak View and Ojai.
Do	Three 2,400-volt and two 440-volt motor control boards, Upper Ojai and Rincon Pumping Plants.
Do	Four sets of chlorination equipment. About 80,000 pounds.
Washita Basin, Okla.	Constructing the 101-foot-high earthfill Fort Cobb Dam. On Pond Creek, north of Fort Cobb.
Weber Basin, Utah.	Earthwork and structures for about 15 miles of Uintah Bench Laterals, 2 small reservoirs; and one pumping plant. South of Ogden.
Do	Clearing reservoir and fencing reservoir right-of-way. Pineview Reservoir, east of Ogden.
Do	Constructing recreational facilities. Wanship Reservoir area, 38 miles east of Salt Lake City.
Do	Constructing two 6-room, brick veneer residences. At Gateway Powerplant, southeast of Ogden.
Yakima, Wash	Furnishing and erecting about 26 miles of protective fencing. Near Kennewick.

[1] Subject to change.

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The Reclamation Era

NOVEMBER 1957

IN THIS ISSUE:

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In this issue . . .

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J. J. McCARTHY, Editor

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IRRIGATION IN THE MIDWEST

A Review by the Federal Reserve Bank of Chicago. Reprinted from its monthly publication. Business Conditions December 1956

Artificial watering of growing crops traces back through antiquity to the transition of mankind from pastoral societies to agrarian cultures. The ancient pyramids of Egypt, for example, were erected by workers fed through the use of a crude type of irrigation. The occasional introduction of new techniques has enabled the practice to persist and spread throughout its history of several thousand years. A relatively recent method—sprinkler irrigation—shows signs of giving the old usage one of its most spectacular boosts.

A farm equipment trade publication has estimated that by 1960 a total of 400,000 farms in the United States will be irrigating 40 million acres, about 10 percent of our cropland. In 1954 some 300,000 farms irrigated less than 30 million acres. This projected increase would require the investment of something like $500 million in new capital, most of it for sprinkler irrigation equipment. Although the above projection may be overly optimistic, it nevertheless indicates the potentialities that this development may contain.

Arid and humid areas

In the United States irrigation was largely confined to the arid West until recently. In that area the predominant method of applying the water involved the flooding of field from canals and trenches supplied by river reservoirs, or deep wells in some cases.

Although east of the Great Plains average annual precipitation is sufficient for most Temperate Zone crops, the moisture supply varies considerably from year to year, as does its distribution within the year. Hence, even in humid areas natural precipitation does not guarantee a fully adequate moisture supply throughout a crop's entire growing season. This can cut the yield substantially, especially if the water deficiency occurs at critical stages in the plant's development. Consequently, the output of many

GENERAL VIEW of irrigation setup.

crops can be raised considerably by irrigation even in humid areas.

Artificial watering on a commercial scale is a rather expensive practice. Installation of the equipment requires a large investment outlay, and annual costs of operating the equipment are high. For this reason, in the eastern half of the United States—where irrigation is not subsidized by Government-developed water supplies—the usage gained its first footholds in areas specializing in the commercial production of vegetables, because these return a high value of output per acre and are especially sensitive to a steady supply of moisture.

In this part of the country, the water is typically applied by sprinklers—large-size relatives of the type commonly seen watering lawns. The water is obtained from wells, streams or ponds and is pumped to the sprinklers through portable pipes. Where a considerable area is involved, the apparatus is moved around the field in order to supply moisture to all parts of it. Obviously, the development of lightweight aluminum pipe has been a boon to this activity.

At Left: This 800-gallon per minute irrigation well on the farm of Harry Haeder enabled him to maintain his livestock feeding program from irrigated crops when dryland crops in the immediate area were almost a complete failure. Center: Sprinklers in operation. At right: James Popple operating sprinkler system.

Sprinklers spreading swiftly

In 1954, according to the Bureau of the Census, a total of 2.6 million acres of farmland was irrigated in the 31 States east of the Great Plains, i. e. east of a line from North Dakota to Texas. Although 10 times as many acres were irrigated in the West, the total in the humid region represented a jump of 73 percent during the previous 5 years, compared with an increase of only 10 percent in the West. In the humid area, very large percentage gains were scored by a number of States along the Atlantic Seaboard and in the Appalachian and Delta regions, as well as in the Corn Belt States of Missouri, Ohio, and Illinois.

Irrigated acreage in District States

Size of farm	Acres irrigated (thousand acres) 1949	1954	Total crop acres 1954
Under 100 acres	7,067	11,251	7,438,963
100 to 219 acres	5,065	12,497	30,036,641
Over 219 acres	20,531	38,847	34,360,277
Total	32,663	62,595	71,835,881

Source: U. S. Bureau of the Census.

Irrigated acreage in Illinois leaped from 1,510 acres in 1949 to 6,789 in 1954. (Total cropland harvested in Illinois comes to about 20 million acres.) Several other States in the Seventh Federal Reserve District had earlier experience with the practice. Michigan and Wisconsin had significant amounts of irrigated acreage already in 1949 (see chart). Nevertheless, those acreages nearly doubled in the succeeding 5 years, with most of the increase occurring on fruit and vegetable farms, the types that previously had accounted for most of the irrigation in that region. In Illinois, Indiana, and Iowa most of the gain in sprinkled acreage occurred on cash grain (primarily corn) farms, although Indiana also showed a significant addition on grain and meat animal farms.

Irrigation in the Seventh Federal Reserve District is not primarily a small farm phenomenon. In both 1949 and 1954 the bulk of the sprinkled acreage was found on farms exceeding 219 acres in size. However, the largest percentage increase between those two dates occurred on farms in the

VIRGIL O. SISSON prepares to check soil moisture as he begins first irrigation of grain sorghum.

99–219-acre size class which includes the majority of District farms.

Water and corn

A considerable amount of experience has now accumulated concerning the irrigation of corn in the Midwest. Purdue University specialists report that irrigation "doubles and triples" corn yields in some sections of Indiana. A 3-year test in northern Illinois showed an average corn yield of 144 bushels per acre on sprinkled land against a 50-bushel yield on nonirrigated soil. In a 4-year Wisconsin test nonirrigated corn averaged 45

CONTRAST: Corn in foreground damaged beyond production because of draught. Corn in background shows Luxuriant tall growth which resulted in timely application of irrigation water coupled with good fertility practices.

bushels per acre whereas full irrigation *plus heavy fertilization* boosted the yield to 96 bushels. Tests by Iowa State College on heavy Iowa soils in 1955 showed an average gain of 40 bushels per acre due to irrigation.

These tests were conducted for periods of only 1 to 4 years, whereas a longer span of time would be desirable for conclusive results. However, an Iowa study of rainfall records has disclosed that there were an average of more than three "dry periods" in June, July and August each year during the past 20 years at Ames. A dry period was defined as 10 or more consecutive days during which there was no more than one-quarter inch of precipitation on any day. "Every year in the past 20 had at least one period of 13 or more days with no effective rainfall; sometimes these periods last 20 days or longer."

COOPERATION—Maurice G. Hill begins final irrigation of his corn with help from his wife who has become very proficient in setting irrigation siphon tubes.

This State study suggests that irrigation of corn might be warranted merely from the standpoint of supplying supplemental moisture during dry spells. However, an important additional advantage of artificial watering lies in the fact that it permits other changes in crop production practices. For example, it has been known that highest corn yields can be obtained from good soils if heavy applications of fertilizer are used along with dense stands of plants, i. e., more than 15,000 per acre. However, moisture deficiency can sharply reduce the effectiveness of fertilizer, and dense stands may actually reduce yields in dry

(Continued on page 104)

Dominy Named Reclamation's Assistant Commissioner for Legislative Liaison

INTERIOR SECRETARY SEATON Presenting Formal Commission of Office to Assistant Commissioner Dominy

Secretary of the Interior Fred A. Seaton recently announced the appointment of Floyd E. Dominy as Assistant Commissioner for Legislative Liaison of the Bureau of Reclamation. Mr. Dominy, who has been with Reclamation 11 years, has served as chief of that agency's Division of Irrigation since 1953.

Secretary Seaton said the appointment was recommended by Commissioner of Reclamation W. A. Dexheimer. Mr. Dominy will assist in representing the Bureau of Reclamation before the Congress on legislative and budget matters.

"The creation of a new office of Assistant Commissioner for Legislative Liaison and the selection of Mr. Dominy to fill that position will greatly assist the Bureau of Reclamation in carrying forward its important program," Secretary Seaton said. "Mr. Dominy, because of his broad knowledge of western irrigation and agriculture, will add important operating knowledge to the immediate top level of the Bureau's staff."

Mr. Dominy joined the Bureau of Reclamation in April 1946, as Chief of the Allocation and Repayment Branch of the Operation and Maintenance Division. He became Assistant Director of the Division in 1950 and Director in 1953. Under the Bureau's reorganization in December 1953, he became Chief of the Division of Irrigation.

Beginning his professional career as teacher of vocational agriculture in Hillsdale, Wyo., Mr. Dominy became county agricultural agent in Campbell County in 1934 and continued in that job until the fall of 1938. He became field agent for the Western Division of the Agricultural Adjustment Administration in 1938 and served until 1942, when he became Assistant Director of the Food Supply Division, Office of the Coordinator of Inter-American Affairs. In this position, he was responsible for developing and directing an emergency food supply program in cooperation with various South and Central American countries.

During World War II, from 1944 to 1946, he served as a lieutenant in the United States Navy. As a military government staff officer on islands of the Pacific reoccupied by Allied forces he was responsible for the development and administration of agricultural programs.

Mr. Dominy was born in Hastings, Nebr., in 1909. He was educated in the Hastings public schools and Hastings College. He obtained his B. A. degree in agriculture from the University of Wyoming in 1932. He has done postgraduate work at the University of Wyoming and Columbia University. He married Alice M. Criswell of Hastings. They have three children and now reside in Oakton, Fairfax County, Va. # # #

Recreation Plans For Pineview Reservoir

Ogden, Utah, and the surrounding area are growing rapidly in population, industrially and especially in water demands. To help meet the water needs, the Bureau of Reclamation constructed the Pineview Dam in 1935–37. This rolled-earth structure, which backs up the Ogden River is 7 miles east of Ogden. It was originally designed to store a maximum of 1,786 surface acres of water.

It was not long before it became apparent that recreation was the dominant use of the water surface and shoreline. Thousands of people swarmed from the Ogden area—Utah's second most thickly populated section—to seek relaxation at Pineview Reservoir.

The nearest other large fresh-water body was Utah Lake, 70 miles from Ogden.

In 1941, the late President Franklin D. Roosevelt, by proclamation, reserved certain lands around the Pineview Reservoir to be included within the Cache National Forest for national forest purposes, including recreation use. This original reserved area proved to be entirely inadequate for the development of a national forest public recreation program as the adjacent shoreline lands under public ownership, were too narrow, steep and rocky. This made it impossible to develop recreation facilities with sufficient shoreline reservation and provisions for sanitation to protect the quality of the water stored.

However, the lack of facilities did not deter an ever-increasing number of people from using Pineview Reservoir for recreation. During the past few years, the number of annual recreation visits to the area have been close to one-half million. If additional development were possible, this number could easily grow to 759,000 visits or about one-half the number that visit Yellowstone National Park each year.

by DONALD B. PARTRIDGE
Landscape Architect
U. S. Forest Service
Intermountain Region
Ogden, Utah

The water needs of the growing Ogden area soon outgrew the water supply available from Pineview Reservoir. In 1955, the Bureau of Reclamation moved to help solve this problem. In July of that a year, work got under way to raise the dam from its 61-foot height to 90 feet, increasing the storage capacity of the reservoir from 44,200 acre-feet to 110,000 acre-feet. The maximum surface area was increased from 1,786 to 2,874 acres.

Plans for expansion of the reservoir capacity intensified the land community interest in the development of provisions for increased recreation use and facility construction. Appropriations for enlargement of Pineview Reservoir by the Bureau of Reclamation included funds for acquisition of lands adjacent to the reservoir as well as funds for the planning and development of the recreation resources.

The stage was not set for the recreation-planning phase of the Pineview Reservoir development program.

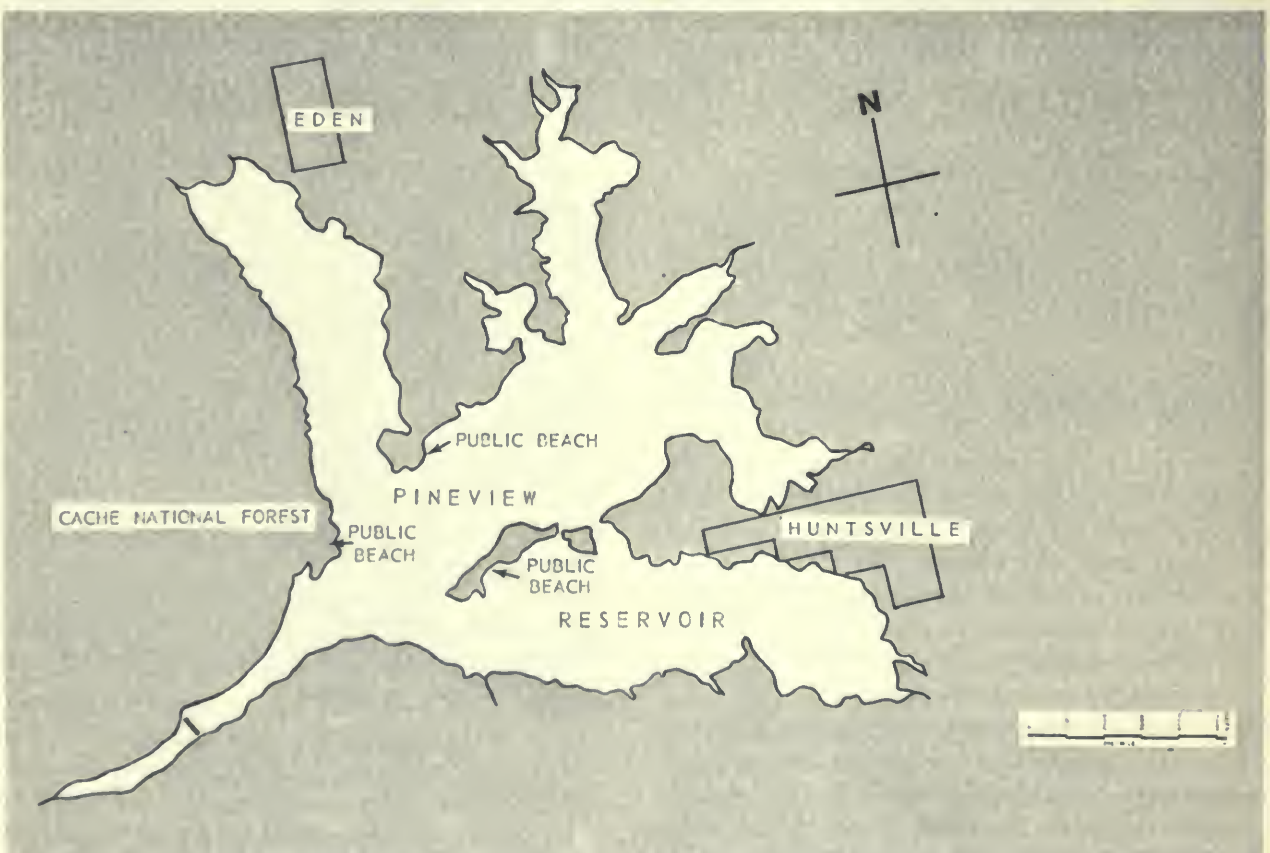
A good close working relationship and understanding evolved between officials of the various agencies concerned. The recreation development of the Pineview Reservoir area is a cooperative program between the Bureau of Reclamation and the U. S. Forest Service. Officials of the National Park Service represented the Bureau of Reclamation and advised them in the classification and planning phase of this program.

A general development or classification plan for Pineview Reservoir was completed and approved in 1951 by officials of the Bureau of Reclamation, National Park Service and U. S. Forest Service.

This classification plan was then followed by the recreation master plan prepared on a larger scale, using Bureau of Reclamation survey maps, enlarged aerial photos and field checks of the preliminary plans for each area. The master plan illustrates the ultimate recommended recreation development desirable.

The Weber Basin Conservancy District and an interested group of Ogden citizens are assisting in

Simplified Drawing of Pineview Recreational Plan.



ENLARGEMENT of Pineview Dam—Weber Basin—Utah. Highway tunnel near the right margin of the picture, now filled with rock identifies the original height of Pineview Dam—*Photo by Stan Rasmussen.*

a program to acquire additional land around the perimeter of the reservoir. Only a part of the recreation development program can be accomplished with the lands now in Government ownership.

The recreation master plan was prepared by the U. S. Forest Service in cooperation with the Bureau of Reclamation and the National Park Service and was approved in 1956. It provides for the development of approximately 640 acres around the reservoir for various types of recreation, including public recreation areas, semipublic, commercial, and summer home areas. The capacities in terms of people per day including the following:

Type	Number of areas	Capacity
		People
Public recreation	15	6,100
Overlook parking	Numerous areas	800
Semipublic	10	1,400
Commercial	4	2,300
Summer home	1	300
Total		10,900

It should be noted that the original general development plan approved in 1951 provided for facilities to accommodate 3,825 people in camp and picnic grounds. The new recreation master plan provided for an additional 2,250 users by 1965.

The master plan has been prepared with the primary concern for sanitation. Camp and picnic facilities are located at least 100 feet back from the high water line and all sanitation improvements are located a minimum of 200 feet back. These provisions are included in the plan to protect the quality of the reservoir waters and assure delivery of a safe domestic water supply to the city of Ogden.

Other factors considered in the master plan

WATER SKIERS on Pineview Lake—*U. S. Forest Service Photo.*

involved provision for public safety, fire protection and adequate and safe water supplies for the recreation users.

The planning phase of Pineview Reservoir under the direction of the U. S. Forest Service is now well along with funds provided by the Bureau of Reclamation in anticipation of a recreation construction program, during the coming year.

A supplemental memorandum of agreement between the Bureau of Reclamation and the U. S. Forest Service for planning, development, and administration of recreation lands around Pineview Reservoir is now in the process of being approved. When this agreement is completed, the next stage or development phase of the Pineview program will be initiated. # # #

"POSTPONE THAT EVIL DAY"

"As has been well said here, the available acres per capita in this country are decreasing at a tremendous rate, and we may reach a state some time where research and conservation won't be able to altogether take care of it. But we want to postpone that evil day as far as we can." Senator Richard B. Russell, Senate Agricultural Appropriations Hearings, fiscal year 1958.

439138 O—57——2

N. R. A.
Convenes At Salt River

PRESIDENT THEODORE ROOSEVELT.

PHOENIX, ARIZONA—This Sunshine Capital of the Southwest will host reclamationists from 17 Western States November 6–7–8 at the 26th annual convention of the National Reclamation association, theme of which will be the 100th anniversary of the birth of the "father of reclamation"—Theodore Roosevelt.

With the Salt River Project, the nation's first major reclamation venture, inaugurating and perpetuating the financial foundation for the Salt River Valley, the site is most fitting for the convention, especially since it will serve as a springboard for a year-long national observance of the Teddy Roosevelt Centennial.

The Salt River Project was organized shortly after the National Reclamation Act, sponsored by Senator Henry C. Hansbrough, of North Dakota, and Representative Francis Newlands, of Nevada, was passed by the 57th Congress and signed into law June 17, 1902, by President Roosevelt.

Less than 9 years later, Mr. Roosevelt, who declined the candidacy for President at the end of his second term in 1908, came to the Valley to dedicate the huge masonry dam named for him. The structure, which hobbled the rampant waters of the Salt, still holds the distinction of being the highest rock masonry dam in the world.

Dedication of Roosevelt Dam was the launching point of the Project which has since constructed five additional storage reservoirs on the Salt and Verde Rivers. Harnessing of the two streams and its attendant flood control and water storage facilities proved to be a godsend to the Valley, known to natives and newcomers as Valle Del Sol (Valley of the Sun).

In the years before reclamation the Valley always faced the problem of too much or too little water. Flash floods, usually occurring in the spring when the mountains shook off their winter blanket of snow, swept away the farmer's handiwork and then in summer the streams disappeared in the sand to become nothing more than dusty ribbons meandering through a desolate wasteland.

However, the miracle of reclamation and irrigation wrought an abrupt change and the Valley's development, since the advent of the Project, has been of the amazing variety. And with an estimated 1,200 to 1,500 new residents moving into Arizona per week there will be no change in the foreseeable future.

Rainfall on the Salt and Verde watersheds is approximately the same as it was before the Project backed the rivers up into lakes, but a similar amount of stored water is now sustaining a half million people instead of the 11,000 existing here then. Prior to 1900 the entire assessed valuation of Maricopa County, of which the Project is the heart, was in the neighborhood of $10,000,000 while the 1957 figure soared to near the half billion mark.

Although the Project's original 241,000 acres have shrunk to 239,000 through the development of subdivisions to accommodate the heavy influx

BEFORE AND AFTER—Cultivated and virgin desert areas appearing in the two photos graphically describe Arizona's Salt River Valley "BEFORE" and "AFTER" organization of the Salt River Project, the Nation's first major Reclamation project. This project has produced nearly $300 million worth of crops in the last 5 years.

of new residents, agriculture still provides the basic economy of the Valley. In the past 5 years the Valley's fertile acres have produced crops valued at nearly $300,000,000.

Reclamationists, who last met here in 1947, will see the many vast complexion changes in Phoenix and environs during the past decade. A committee headed by R. J. McMullin, general manager of the Salt River Project and president of the Colorado River Water Users' Association, was hard at work ironing out a well-rounded program of entertainment for the visitors as this issue of the *Era* went to press.

Stage backdrops, printed programs, tour brochures and many other accouterments associated with the 3-day conclave will carry out the theme of Teddy Roosevelt Centennial. One of the outstanding tour features will be the Rough Riders Roundup luncheon at the Salt River Project Employees' Recreation Association area with the piece de resistance being husky charcoal-broiled steaks.

J. H. (Hub) Moeur, president of the Arizona Reclamation Association and Arizona director of the National Reclamation Association, along with Mrs. Moeur, will be the official host and hostess for the convention. Among the list of topnotch speakers for the occasion are Under Secretary of the Interior Hatfield Chilson; Bureau of Reclamation, Commissioner Wilbur A. Dexheimer; United States Senator Clinton P. Anderson, of New Mexico, former Secretary of the Department of Agriculture; Arizona Gov. Ernest W. McFarland; and Arizona's own senatorial delegation, Carl Hayden and Barry Goldwater, and Senator Frank A. Barrett of Wyoming.

Mr. Murray Walker, president of the Association of Western State Engineers, is also scheduled to be a speaker at the convention.

Other Interior Department and Bureau of Reclamation officials selected to attend the 24th Annual Convention of the NRA were Associate Solicitor, Water and Power, Edward W. Fisher; Assistant Commissioners of Reclamation Floyd E. Dominy and E. G. Nielsen; Assistant to the Commissioner, Information, Ottis Peterson; Acting Chief, Division of Irrigation, William I. Palmer; and Chief, Division of Project Development, N. B. Bennett. # # #

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30 Years Ago in the Era

PRINCIPLES WHICH SHOULD BE INCLUDED IN SUCCESSFUL LAND SETTLEMENT

Settlers must be selected. Developing farms under irrigation requires a certain amount of capital and certain definite qualities. Without these only disappointment can result.

They must be settled on the land, not in isolated units, but in groups or colonies of sufficient size to secure economic and social advantages.

There must be aid and direction in the preparation of the land for irrigation. In this, cooperation is important. Settlers working as a community can do many things better than as individuals working alone.

Many settlers who love farming and who, if given a chance, wil lbecome good farmers, have inadequate capital. They should be helped to get a start by means of credit banks or other special arrangements.

Markets must be studied, crop rotations suggested, and a program of marketing worked out suited to the conditions which govern transportation from the producers to markets.

The payments of the initial years must be made as easy as possible.

The aim should be ownership of small farms rather than tenancy on larger estates.

ELWOOD MEAD
Commissioner of Reclamation

COLUMBIA BASIN'S PARTNERSHIP PROGRAM

by E. H. NEAL

Irrigation Supervisor, Columbia Basin Project, Ephrata, Wash.

On the Columbia Basin irrigation project in the State of Washington the directors of each of the three Irrigation Districts call public meetings each winter to discuss the common problems of the Districts and the water users. These annual "stockholder" meetings have been held in each Irrigation District, usually in January or February every winter since water deliveries to the project lands began. They have been well attended, some meetings having as many as 125 persons present and always those present have evidenced their interest by questions and comments.

This big irrigation project for which facilities are now completed to serve 350,000 irrigable acres and which eventually will serve 1 million acres was organized into three Irrigation Districts because of the widespread area and to give as much local representation as possible to the various communities. The Quincy Columbia Basin Irrigation District is in the northwest portion of the project, with headquarters at Quincy. The East District in the northeast part of the project with headquarters at Othello, and in the southern part of the project is the South District with headquarters at Pasco. Quincy is 20 miles west of the project headquarters at Ephrata, Othello is 45 miles southeast of Ephrata, and the headquarters of the South District at Pasco is 90 miles southeast of Ephrata. Due to the size and distances, the problems of communication between the Irrigation District and its "stockholders" and the Bureau of Reclamation and the landowners and water users have required considerable attention.

The programs at the different annual stockholder meetings have varied. Subjects discussed have covered a wide range, including the functions and policies of the Irrigation District Boards, water allotments, policies in water delivery and charges and assessments for water services, the Columbia Basin Act and features, and repayment contracts. Considerable time has been given in various of the meetings to discussion of irrigation practices and how to meet the problems peculiar to the soil and climate of the Columbia Basin. In recent years drainage problems and financing drainage have been subjects of considerable interest. In all of the meetings there have been ample opportunities for water users to present problems of general interest and for discussion of such problems. In addition to discussions by directors and secretaries of the Irrigation Districts, the Extension Service, Research Workers from the Experimental Stations, and Bureau officials have taken part in the programs. Meetings of this kind present a good opportunity to discover water users' problems; to acquaint them

with reasons for Bureau policies and to strengthen cooperative relationships. An example of how the meetings work:

George Crane, who owns and operates a farm in one of the lighter soils areas, speaks—"Mr. Chairman, I had to use 6½ acre-feet of water my first year to grow beans. My allotment is 4 acre-feet. I should not have to pay excess water rates on that 2½ acre-feet. If 6½ acre-feet are required to grow beans, how much will be required to grow alfalfa?"

The chairman called on the Bureau's Irrigation Division representative, who explained briefly that more water is often required the first year in preparation for leveling, to fill the rootzone, and because of inexperience in handling water in this area. He then called on a land-classification man who explained how this particular soil was being studied in the light of recent irrigation experience to see if an increase in water allotment was justified. A Settler's Assistance Extension Agent then told of where to look for ways of saving water, and of the assistance towards more efficient irrigation that could be obtained from the Extension Service or the Soil Conservation Service.

The results have been that on the Columbia Basin Project there is a well-informed group of water users who have an understanding of both Irrigation District and Bureau of Reclamation policies and the special problems of irrigation and production on the soils peculiar to the Columbia Basin Project. More important, the water users have become acquainted with their elected officials water user's organization. While the project area

Onion sacks create a "FOREST" on the farm of Bill Hattori near Moses Lake, Washington—*Photo by H. E. Foss.*

and have had an opportunity to present their complaints and gripes.

The monthly meetings of the Irrigation District Boards, are, of course, open to the public and all the Boards extend invitations to all their water users to come before the Board and present their problems.

It is the announced policy of the Bureau of Reclamation to transfer the responsibility for operation and maintenance of irrigation facilities to water user organizations as soon as the facilities are complete and reasonably stabilized, and the water user's organization is competent, willing, and financially able to operate and maintain the works.

This time is some years in the future on the Columbia Basin Project, but active steps are being taken to prepare the way for this transfer of the operation and maintenance responsibility to water user's organization. The District boundaries do

HERBERT SWOFFORD irrigating netted-gem potatoes on his Royal Slope Division farm—*Photo by Stan Rasmussen, Region 1.*

Closeup shows Bob Faw, left, and a harvest hand sacking peas on his Columbia Basin farm—*Photo by F. B. Pomeroy, Region 1.*

not coincide with the distribution systems. The District boundaries in a general way follow artificial boundaries, while the irrigation system, using good engineering practice, is based on topography without regard to the artificial lines of the District boundaries.

A major premise in the project plan set forth in the repayment contracts is that location on the irrigation system, and the method of furnishing water to the lands, whether from the so-called gravity system or by pumping from that system, is not to be the basis for assessing operation and maintenance charges at different rates by reason of the method of water delivery. It is agreed, however, that it is in the best interests of the project for the operation and maintenance charges to be related to the relative productivity of the lands.

It is believed that the operation of the project, when the water users are willing and able to take over, should be through some form of an operating agency under the supervision of the elected directors of the three districts. In addition to the necessity for such, due to the engineering features of the system and the desire to equalize charges, there are many economies and efficiencies that will result from operation as a single entity.

To prepare the way for such eventual operation by the water users, a very close-working relationship between the Bureau of Reclamation Staff (Irrigation Division) which is now operating the facilities, and the Directors of the Irrigation Districts has been established. # # #

Fertilizer Growth Helps Keep Farming Our No. 1 Industry

(*Reprinted from Rural Marketing, April 1957*)

"American agriculture is the Nation's biggest industry—4,800,000 farms with an equity of $149 billion and spending for operation of its farm plant between $12 and $14 billion a year on machinery, equipment, buildings, fertilizers, feed, petroleum products and other goods and services."

To keep the Nation's number one business in high gear requires use of the latest methods and materials, continues Vincent Sauchelli, chief agronomist of the Davison Chemical Co., division of W. R. Grace & Co., Baltimore. "The two most important factors responsible for the tremendous productive capacity of American farms are the expanded usage of power equipment and chemical fertilizers."

Sauchelli goes on to say, in an article in Chemurgic Digest, that chemical fertilizers are an "indispensable tool" in today's farming operations and make possible a "substantial part" of cash farm income. "It is estimated that about 30 percent of the country's crop production can be attributed to the use of fertilizers," he adds.

"Today's commercial farmer is using mechanization, good management practices, fertilizers better suited to his soil needs as determined by soil tests, and better seed and breeds of livestock to enable him to succeed.

"Manual labor and animal power have yielded to automotive and machine power, and animal droppings to balanced chemical fertilizers."

Continues Sauchelli: "Since 1939, consumption has hit a new high record each year. In 1955, American farmers used about 21 million tons of fertilizer, almost 40 percent more than in 1946 and valued at more than $1 billion.

"It is fair to say that, for every dollar invested in fertilizers, the average return is from $3 to $5. Many of our commercial crops could not be grown in many sections of the country without the aid of fertilizers. Twenty-five to fifty percent of the production of cotton, tobacco, citrus fruits, potatoes and many vegetable crops comes from fertilizers."

As for America producing more food and fiber than it consumes, Sauchelli predicts that present day surpluses "will be envied" a generation hence when, by 1975, about 200 million Americans will need at least 30 percent more food than is now being produced. # # #

The Handicapped Pull Own Weight on Reclamation Team

In cooperation with the President's Committee on NATIONAL EMPLOY THE PHYSICALLY HANDICAPPED WEEK, proclaimed by Hon. Dwight D. Eisenhower October 6–12 we present this year's story of handicapped people in the Reclamation area who are pulling their own weight.

IONE CARROLL—*Photo by N. F. Novitt, Region 7.*

Mrs. IONE CARROLL, by accepting the fact of a physical handicap, has kept it from being a disability. Capable Ione carries out her full and uninterrupted duties as a clerk-stenographer in the Region 7 headquarters at Denver just as though she didn't have a stiffened and braced leg that results from poliomyelitis.

Doctors at Lander, Wyo., were baffled when 22-month-old Ione Marion was paralyzed within a matter of hours—back, right hip, and right leg. In 1927, the dread term "polio" was unknown, and months went by before the paralyzing illness was identified.

Today, Ione is one of the Nation's most grateful boosters of the Shrine Hospital for Crippled Children at Salt Lake City. Entering at about 4 years old, she underwent surgery and remained a year. Although she first walked at the age of 6 with the aid of crutches and braces, she returned to the hospital every 6 months until she was 16.

Since May 1951, Ione has had stenographic duties in Region 7, specializing in statistical shorthand and typing. Her present assignment, appropriately, is in the Programs and Budget Branch. Last May she was married to Lawrence W. Carroll, employee of a wholesale dry goods company.

"Ione asked, when she came into this office, to be treated just the same as anyone else would be," said E. T. Seeley, branch chief. "We've done just that. And I can honestly say her job performance is excellent, not impaired or even influenced by her handicap."

HELEN FRAUSE, despite polio handicap in both legs, was not kept from earning five awards and other honors before coming to work in the Commissioner's office as a dictating machine transcriber. Although her only means of locomotion is crutches, she is by far the most cheerful employee in her unit, as she considers her problems her own and no one else's.

Miss Frause was stricken with polio when she was 9 years old. She spent 10 months in a hospital, and, she says, it took another 14 months to get back to normal.

Upon graduation from the eighth grade, she was presented with a bronze plaque, a pin, and a certificate by the Boulder County (Colo.) American Legion Post for outstanding scholastic work. In 1952, 1953, and 1954 she won the top cash prize offered each year by the Boulder County Elks for writing articles on what she did to compensate for her handicap and what her goal was after graduation.

During her senior year at Louisville (Colo.) High School she was president of the Louisville chapter of the Future Business Leaders of America, an organization composed of commercial students in high schools and colleges. She was also president of a high-school commercial honorary society and won that organization's award for outstanding high-school commercial scholarship.

Upon graduation she was selected to address the convention of the Mountain and Plains States chapters of the FBLA held in Denver in June of 1955. She was the only high school student so honored.

Miss Frause had been with Reclamation just over 7 months when her performance earned a promotion, and her cheerful attitude has caused many a "major" problem of other employees to melt into insignificance.

FOREST HOOVER, a staff sergeant, was aboard a Douglas bomber that took off on a training flight from Tonapah, Nev., to Tacoma, Wash., in 1943. Five hours later, out of fuel, and surrounded by stormy weather, the plane crash-landed in a cold and isolated area of central Idaho. In the crash, Forest's right foot was jammed and broken. During the 16 days the bomber crew waited for rescue the foot was frozen, and by the time medical attention was available, amputation was necessary. After 7 months' hospitalization, he was discharged.

Now, 12 years later, that experience probably seems like a bad dream to Forest as he cheerfully goes about his duties as an engineering aid engaged in technical investigations of Hoover Dam and Lake Mead on the Boulder Canyon Project.

It doesn't seem quite right to speak of Forest as a handicapped person because he has so overcome his disability that his fellow workers never think of him as such. His work takes him into some rugged terrain around Lake Mead above Hoover Dam, along the Colorado River below the dam, and also into the interior of the dam

HELEN FRAUSE.

where he is required to negotiate steep stairways and narrow passageways carrying a load of instruments and equipment. Despite these conditions Forest always seems to manage to do a little more than his share.

SALT RIVER PROJECT

More than a score of persons, handicapped in varying degrees and with a number of veterans in their midst, are on the employment roster of the Salt River Project in Central Arizona and in every case adjustment has been successful.

Project executives are fully cognizant of the importance of the "employ the physically handicapped" program and the plan is applied wherever and whenever possible.

CLAUDE AXTELL, account clerk in the Project irrigation service department, and CLYDE GORDON, offset printer in the Project print shop, are outstanding examples of employees who have adjusted to compensate for their handicaps, although AXTELL is somewhat of a junior partner in the combination.

In 1956, AXTELL underwent surgery for amputation of both legs, the left leg above the knee in May and the right below the knee in October, a circulatory condition necessitating the treatment.

When he was first employed by the Project, AXTELL was assigned to the field as a special service zanjero (ditch or water tender) in subdivisions, but after 3½ years of this work his physician recommended inside duties because moisture was aggravating his condition. His transition into the handicapped category was a gradual one. Several toes were removed from each foot before the decision was finally made to amputate his legs.

For a fellow who played 8 years of semipro football and always led an active life you'd think the amputation of his legs would tend to dim his anticipation of the years to come. But not so for AXTELL. He submitted to the amputations with the same fighting spirit he displayed years ago while playing safety man and fullback in Susquehanna, Pa., viewing the surgery as something to relieve his suffering rather than a hindrance the rest of his life.

FOREST HOOVER—*Photo by F. S. Finch, Region 3.*

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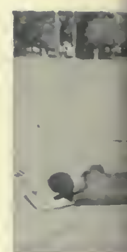

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GORDON's right leg was crippled by polio when he was 16 years old, but he staged a successful comeback now the handicap is no deterrent so far as his work and recreation are concerned. He was stricken with infantile paralysis while a sophomore in high school at Connersville, Ind., the disease withering the tendons of his right leg. Shortly after dismissal form the hospital, he learned to walk with the aid of a chair, then graduated to crutches and a cane. Finally he was fitted with a heavy brace enabling him to discard other walking aids.

His improvement was such that he reentered high school and extended his activities to playing center on his church basketball team. During his final years in high school the coach noticed his sharp interpretation of baseball plays, as well as his unlimited courage, and urged him to apply for admission in the Indiana High School Umpires' Association.

For a quarter of a century GORDON "called 'em as he saw 'em" and traveled thousands of miles umpiring baseball and softball games, han ling about 150 contests a year. However, in 1948, GORDON curtailed his activities on the diamond and sought other employment to supplement his income. That was when he became associated with the Project, and has since developed into a top employee in the print shop where practically all of the Project's printed material is produced.

Currently he is booking agent for the Arizona Umpires Association and recently was selected as an alternate umpire for the Arizona-Mexico League.

MAROLF BERYL BERGER began his Government career on October 2, 1939, at La Junta, Colo., as an Engineering Aid for the Soil Conservation Service on a short-

TELL.

MAROLF BERYL BERGER.

JOHN E. ROBINSON with Mrs. Blanche Reuber, appointment clerk—*Photo by Ed McCloud, Region 1.*

ON.

GEORGE G. SCHOEPKE.

term appointment. In January of 1940 he accepted a temporary appointment with the Forest Service at Fort Collins, Colo., and worked there until coming to work for the Bureau of Reclamation on October 19, 1940, as a Junior Engineer, at Pueblo, Colo. He was furloughed on August 19, 1941, to enter the Armed Forces. He served in the Field Artillery and rose to the rank of major.

In the Italian Campaign of World War II Mr. Berger received injuries which resulted in the loss of both legs. He returned to duty with the Bureau in the Project Planning Office at Oklahoma City, Okla., as an Engineer P–2 on January 7, 1946. Despite his handicap he has always been able to perform all duties to which he was assigned. He has never delegated field work to his assistants when he felt that the field work required his attention. Although most of his work is performed in the office, he quite frequently goes to the field to perform Hydrology inspection or work. He has progressed to the position of Chief of the Hydrology Section of the Oklahoma City Office.

His cheerful and willing attitude and versatile ability has made him a well liked and highly respected employee and citizen.

GEORGE G. SCHOEPKE was stricken with poliomyelitis at the age of 11 years. He was hospitalized for the following year. Both legs were completely paralyzed and his back and right arm were partially paralyzed. Through physiotherapy treatments and a grim determination over a 5-year period, Mr. Schoepke regained the partial use of one leg and the full use of his back and arm. He now gets around very well with crutches and drives his own car.

Mr. Schoepke's career in Government service began in 1944 with the Corps of Engineers in St. Paul, Minn. He transferred to the Bureau of Reclamation at Parker Dam, Calif., in 1946.

Now employed by the Middle Rio Grande Project at Albuquerque, N. Mex., as a Supervisory Draftsman in the Design Branch, Mr. Schoepke's handicap seems to be no handicap at all. His pleasant personality and excellent drafting ability have won the friendship and esteem of all who know him.

COLUMBIA BASIN PROJECT

The Columbia Basin Project is quite proud of its record in placement of handicapped and disabled employees throughout all segments of its operations.

JOHN E. ROBINSON, who, as a result of a serious disease contracted while with the Seabees in Okinawa during World War II, was required to have his right leg amputated. He was forced to give up his interest in a lucrative building construction business. His experience and educational background, although not sufficient to qualify him as a professional engineer, provided him with the background to take on a desk-type job that required the ability to work with, understand, and write up engineering specifications. Previously, only professional en-

gineers were used in this type of work. Although classified by the Veterans' Administration as 100 percent disabled, we feel that this man is ideally suited to the job to which he has been assigned.

HARLAN G. STANLEY is a farmer in the rich agricultural empire which has sprung out of a desert on the Columbia Basin Irrigation Project. But he has to do his farming without legs—his were amputated at the hip when he was 8 years old.

Stanley, who was raised on a farm in southeastern Kansas, returned to farming when he came to the Columbia Basin only after he had piled up a good work record in other lines.

During World War II, he was a sheet metal man for the Boeing Airplane Co., in its Seattle plant, a job in which he asked for no favors from his fellow workers and one in which he turned out his share of vital aircraft assembly.

The 45-year-old Stanley is 35½ inches tall and says, "I figure I'd be about 5 feet 8 inches tall if I had legs."

HARLAN G. STANLEY, sitting on tractor with his partner GEORGE F. ROESBERRY—*Photo by Ed McCloud, Region 1.*

Artificial limbs have been dismissed "as a nuisance" by Stanley who explains he has been fitted for them and can get around but the stubs of his legs are too short for efficient use of artificial legs. His legs were lost as a result of blood poisoning which developed from bruises. He also lost the middle finger of his left hand at the same time.

Though many people turn to a desk job or other sedentary work when they lose a limb, Stanley found that kind of work was not for him. "It gives me a case of nerves and I wind up with indigestion. I have to be able to move around."

He bought a 200-acre unit and then, realizing there would be things on the farm impossible for him to do, he took in George Roesberry, 46, as a partner on a sharecrop basis. Roesberry came to the farm last fall and Stanley followed this spring.

In spite of his handicap, Stanley operates all the farm machinery and drives his own car—one on which he rigged up hand controls for clutch and brake and with a throttle which is controlled by shoulder action.

FREDERICK C. BYRNES is employed as a Physical Science Aid in the Soils Laboratory of the Missouri-Souris Projects Office in Bismarck, N. Dak. He holds a bachelor's degree in soil science from the University of Connecticut and a masters degree from Oklahoma A. & M. Mr. Byrnes was employed by the Bureau of Reclamation in Montana from June 5, 1950, to July 3, 1953, and in Wyoming from April 2, 1956, to September 30, 1956, as a Soil Scientist (Land Classification and Survey). It was, however, necessary to separate him from this position because his impaired vision and hearing made it impossible for him to get a State driver's license and therefore he was unable to operate a vehicle for transportation to and from the work sites. He has a hearing loss of 65 percent. His vision was impaired as a result of scarlet fever when he was a child.

FREDERICK C. BYRNES.

Now that his duties are confined to laboratory work, his physical handicaps are not so critical and he is doing an excellent job. # # #

Subscriptions

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All subscriptions should be sent direct to the Superintendent of Documents, Government Printing Office, Washington 25, D. C. Requests for changes in mailing address, renewals, and separate copies should also be sent direct to that agency.

Water Report

By Homer J. Stockwell
Snow Survey Supervisor, Soil Conservation Service, Fort Collins, Colo.
and
Norman S. Hall
Snow Survey Leader, Soil Conservation Service, Reno, Nev.

Willamette Valley—Scenic view of the North Santiam River—*Photo by Stan Rasmussen, Region 1.*

Water supplies in western United States during the summer of 1957 were better than anticipated in early spring. Snowfall in the mountain areas was unusually heavy during the late spring months ranging up to 300 percent of normal for the period. Cool temperatures prevailed. Maximum snow packs of record for June 1 were recorded at high elevations in a few places. Precipitation during the snowmelt season was above normal. Runoff from snowmelt was well distributed over a long period. The relationship between streamflow and water demand was almost ideal for supplying immediate requirements and improving reservoir storage. This improvement in reservoir storage, coupled with relatively wet mountain soils tends to indicate a fair to good water supply for 1958 if snow pack next winter is near normal.

This favorable 1957 water report and 1958 outlook does not extend to southern New Mexico, the highly developed Salt River Valley of Arizona, nor to southern California. In this southwest area, streamflow from the heavy snow pack was not as much as would have been expected some years ago. The years of drouth had taken a toll of water reserves which could not be recovered in one good snow year. Average surface water supply in these areas is far short of meeting demands. These facts must be considered in appraising relative water conditions.

Yet, on the fringe of the last year's drouth area in Colorado, Utah, New Mexico, and Wyoming, the improvement in water outlook was remarkable. Last spring, reservoir storage was down, mountain soils were dry, and irrigated areas had experienced drouth. Mountain snowfall was well above normal but the outlook was considered only fair. Precipitation during April and May was so much above normal that the entire outlook changed. Delay in snowmelt caused concern as to the possibility of local snowmelt floods. Action was required by local agencies in widely separated places to alleviate possible flood damage. Due to lack of demand, a high proportion of streamflow was stored and is still available for future years.

In the more favored region of the Pacific Northwest where water supplies have been adequate for most needs in recent years, total streamflow was also more than expected on April 1. Especially heavy streamflow occurred in May and early June. For the remainder of the summer months streamflow was below normal. On the main stem of the Columbia River streamflow was among the lowest of record for August and early September, causing adjustment in power production schedules. Flows were tending to increase at the end of September. A similar pattern of summer streamflow occurred in Montana, Idaho, Nevada, and California.

Considering the size of the final snow pack, extremely high peak flows were rare. Minor flood damage occurred in isolated areas of Utah, Colorado, and Washington. In all of the West, streamflow from snowmelt extended over a long period—from April to early August.

The flow for April–September of the major streams of the West is indicated by the following tentative records in approximate percent of normal. Colorado River at Grand Canyon, 130 percent; Rio Grande at Otowi Bridge, 110 percent;

Missouri River at Toston, 105 percent; Columbia River at The Dalles, 100 percent; Sacramento River inflow to Shasta, 103 percent; San Joaquin below Friant Reservoir, 81 percent.

Mountain soil moisture conditions are reported as fair to good as of this date except for the mountain areas of Washington, Oregon, and Idaho.

Looking forward to 1958, and assuming a normal snow pack, water supplies will be good where carryover storage is well above normal. Exceptions are the heavy demand areas of the Southwest. Where reservoir storage is not available water supply will depend entirely on next winter's snow pack and rainfall during the growing season.

This analysis is again presented in the *Reclamation Era* through the courtesy of the authors, and *Mr. R. A. Work*, Head, Water Supply Forecasting Section.

In the following paragraphs water conditions by States are briefly reviewed along with a summary of present conditions that will affect the 1958 water supply.

ARIZONA—Above average summer rains improved the water outlook. Most benefit has been to the range lands in the southeastern and central eastern sections of the State. Water holes filled and range grasses had good moisture conditions. Reservoir storage for irrigation still remains low at about 60 percent of average and 12 percent of capacity, excluding storage on the Colorado River. It is only slightly better than last year. Above average winter runoff will be required to supply adequate storage for next year's irrigation. Overdraft of the ground water supply continues in order to supplement the limited surface water supply.

CALIFORNIA—The California Department of Water Resources reports that water conditions during the spring and summer months were generally satisfactory in all areas north of the Tehachapi Mountains. South of Tehachapi Mountains water shortage continued to be a significant problem.

Precipitation during May was much above normal in most portions of the State, resulting in near normal runoff in streams of the Central Valley, north coastal and Lahontan areas. April–July unimpaired runoff of major Central Valley streams was 10,860,000 acre-feet as compared with normal runoff of 13,020,000 acre-feet. Runoff of streams in the central and south coastal areas, however, was much below normal.

All major reservoirs serving the Central Valley, with the exception of Isabella (data not available for water supply table) on the Kern River, filled during the runoff period. This was a major factor in producing adequate water supplies in the Central Valley during the irrigation season.

As of October 1, 1957, there were 6,759,540 acre-feet of water stored in 38 major reservoirs serving the Central Valley. This was about 117 percent of 10-year average (1947–56), 65 percent of usable capacity for that date, and about 500,000 acre-feet less than that in storage on October 1, 1956.

COLORADO—For the first time in 5 years water supply was adequate for all irrigated areas. Water supply outlook changed from fair to excellent during April and May when snow pack increased up to 300 percent of normal. Streamflow over the State was well above average with a few streams flowing near a maximum of record. Cool temperatures during the snowmelt period resulted in delayed melt, relatively low peak flows, and an extremely favorable distribution of snow melt in regard to time. Rainfall in irrigated areas cut demands during the summer. Storage in irrigation and municipal reservoirs increased from a dangerously low point to the present favorable carryover. Overall storage has increased from only 20 percent of capacity last spring to about 70 percent of capacity as of this date. Improvement of storage has relieved the previous critical water supply outlook for the city of Denver.

For the 1958 season the outlook is more favorable than for any year since about 1949. In addition to excellent carryover storage, mountain soils are relatively wet in direct contrast to recent years. In areas where subsoil moisture is used for irrigation, ground water has been brought back to desired levels. With an average snow pack during the 1957–58 winter season, water supplies for next year should be reasonably adequate for the State. If snow pack is less than average, limited shortages can be expected for areas of the eastern slope lacking large supplemental water supplies.

IDAHO—Early snow surveys of 1957 indicated a near normal water supply for central areas and considerably below normal for the northern and southern portion. Above normal snowfall late in the winter improved the outlook. By April 1 near normal flow was indicated for all Idaho streams. An especially wet May substantially increased runoff prospects and in many cases actual runoff was greater than expected.

Idaho had a good irrigation season with high carryover storage for next year. Total reservoir storage is considerably better.

The water outlook for next year is good on rivers with storage, such as the Boise, Payette, and Snake. Water supply for the smaller southern tributaries of the Snake is subject almost entirely to the snow pack accumulation and spring rains of each individual year.

Watershed soils are very dry due to limited precipitation throughout the summer. Watershed recharge from fall rains or from snowmelt next spring will require significant amounts of water.

KANSAS—Water supplies for the irrigated area along the Arkansas River were adequate except for early season. Streamflow in the Arkansas River was high in Colorado. Storage behind John Martin Reservoir available for irrigation early next season is nearly 10 times normal (data not available for water supply table).

MONTANA—The 1957 agricultural season has been outstanding. Irrigation water was plentiful; spring rains were well spaced for time and volume; dry land wheat farms experienced good yields. Range land produced above average forage for livestock. Hay crops have been average or better and good harvest season weather was experienced.

Streamflow from the snow pack maintained above average stages throughout the growing season. Current reservoir storage holdover is good. No drouth conditions have been reported. If 1958 snow pack proves near normal, water supply outlook will be favorable.

NEBRASKA—Streamflow in the North and South Platte Rivers provided adequate water supplies for irrigated areas in western Nebraska. Precipitation has been slightly better than average. Storage in the large reservoirs in Wyoming is well above normal. With near average mountain snow pack and 1958 summer precipitation the outlook for next year is good.

NEW MEXICO—Water supply for the 1957 season was much improved over the past 4 years but did not allow for full recovery from an extended drouth. Summer rainfall was much above average in northern New Mexico, but below average in the south. Because of the unfavorable outlook in the spring and several years of drouth, reduction in crop acreage was extensive. The unusual increase in snow pack in the northern New Mexico and southern Colorado section of the Rio Grande watershed in the late spring months caused snowmelt season streamflow to be greater than expected. The combination of decreased demands and greater than expected streamflow resulted in some increase in storage on the Rio Grande and its tributaries. Reservoir storage capacity on the

Rio Grande is great enough to store 2 to 3 years of normal streamflow, but presently contains less than one-third of capacity and only about one-half of the 1938–52 average. It will take even more favorable runoff years to relieve the concern as to water shortage along this stream.

Crop conditions along the Pecos in New Mexico were fair to good with favorable late summer streamflow caused by rainfall on the headwaters of the stream. Water supplies were fairly good along the Canadian and excellent on the San Juan.

NEVADA—Cool temperatures and above normal precipitation during April and May improved water supplies throughout the State. All major reservoirs, except Rye Patch Reservoir on the lower Humboldt River, were filled during the spring runoff. With runoff less than the 1938–52 average, filling was accomplished because of good carryover storage from the previous year.

Ample water was available for irrigation and other needs. Cool temperatures caused slow melting of the mountain snow pack resulting in a long-sustained runoff. Even water users on unregulated streams had sufficient supplies. This has been one of the best runoff seasons in Nevada in recent years.

Lovelock Valley, served by Rye Patch Reservoir on the lower Humboldt River, ended this irrigation season with carryover storage of about 53,000 acre-feet. This represents above 30 percent of capacity or 62 percent of the October 1, 1938–52 average and is the best since the fall of 1953.

Current fall precipitation in the mountain watersheds is improving the prospects for next year's water supply. Without this timely precipitation watershed soils would likely remain dry until snowmelt next spring. Before appreciable 1958 runoff occurs, these mountain soils must be primed either from fall rains or spring snowmelt.

State-wide reservoir carryover storage for next year is good. The larger reservoirs contain near normal or above the October 1, 1938–52 average while some of the smaller reservoirs are below the October 1 average. However, the current fall mountain precipitation plus good carryover storage point to another good water supply next year if 1958 snow pack should prove near normal.

State-wide reservoir storage as of October 1, 1957 is 58 percent of usable capacity and 106 percent of the October 1, 1938–52 average.

OKLAHOMA—In contrast to outlook last spring, water supply for the Altus Project in western Oklahoma proved good in 1957. Summer rainfall was above normal. At the end of the season the W. C. Austin Reservoir contained about 85,000 acre-feet of water or about one-half of capacity. Storage in this reservoir is dependent on runoff from local rainfall.

OREGON—With the exception of irrigated areas served from small, low-elevation streams, water supply in Oregon has been adequate as was expected last spring. Streamflow ranged from near normal to 20 percent above normal. Some excellent fall rains have occurred this year, but mountain watersheds in eastern Oregon are not as thoroughly primed as a year ago.

Carryover water supplies in irrigation reservoirs are 114 percent of average.

SOUTH DAKOTA—Soil moisture conditions throughout the State are about average for this time of year. Reservoir storage is less than that for the past few years, standing at 88 percent of the past 5-year average. Water supplies in the Black Hills for 1957 were close to average.

TEXAS—Along the Rio Grande in western Texas, water supplies for crops planted were reasonably adequate. A substantial reduction in acreage occurred as a result of the extreme shortage of early irrigation water. Carryover reservoir storage from last year was practically nonexistent. The area near Pecos served by Red Bluff Reservoir had practically no surface water in sight and only a limited amount of feed crops were planted. The 20,000 acre-feet now stored in Red Bluff Reservoir has a high salt content (data not available for water supply table). In the pump-irrigated areas of Texas, crop conditions were good. Storage as of October 1 in the large reservoirs of central and eastern Texas has improved substantially over that for the past 4 or 5 years.

UTAH—Irrigation water supplies have been adequate throughout most of the State this summer. While a few small areas in the southwestern part of the State have reported water shortages, no major shortages of serious consequence occurred.

Above normal rainfall in late spring and early summer months greatly improved the water situation in southern Utah. Cool weather delayed snowmelt so that streamflow held up during the later summer months much better than would normally have been the case. Spring storms, while increasing streamflow, also made it possible to eliminate early irrigation and to save reservoir water.

In central and northern areas the cool, wet spring built up abnormally heavy snow packs at the higher elevations which subsequently resulted in some flood damages.

All reservoirs in the State, with the exception of those on the Sevier River, have ended the season with average or better supplies to be carried over to next year. On the Sevier River, however, combined storage in Otter Creek, Piute and Sevier Bridge Reservoirs (data not available for water supply table) is only one-third of average so that a heavy snow pack is needed here this winter to assure adequate supplies for next summer.

WASHINGTON—During the irrigation season of 1957, water supplies were generally adequate throughout the State. Runoff from the winter snow pack was very heavy during the month of May. High water conditions were experienced along some of the streams in the State and several local areas were flooded from flash water early in the year. With heavy runoff during May, the total irrigation runoff was above that expected. May was the only summer month when streamflow was above normal. Precipitation during the latter part of the irrigation season was generally below normal in the high mountain watersheds. Watershed soil moisture conditions, therefore, are very poor.

September precipitation for the Yakima Valley was the lowest on record. Total reservoir storage as of October 1 is much below normal. The five irrigation reservoirs on the Yakima River now store water to 18 percent of capacity. Unless a normal or above amount of snow falls on the upper watershed this winter, irrigation supplies for the coming season could be short.

WYOMING—Surface soil moisture in irrigated areas ranges from normal to well below normal. However, subsoil moisture throughout Wyoming is considerably above normal for this time of year due to heavy summer rainfall. Assuming that subsequent precipitation for October proves close to average, range land should enter the winter with good moisture conditions.

Because of the especially heavy precipitation during the late spring and early summer months, streamflow in Wyoming was substantially above that expected from snowmelt runoff, particularly in the North Platte Basin. Irrigation water supply for the 1957 season was therefore more than adequate for the State.

Present reservoir storage is 132 percent of normal and will provide an adequate carryover for the 1958 seasonal requirements.

# # #

YOUR MAGAZINE

Are there particular types of articles which you would like to see in the ERA that we have not printed to date? If so, please let us know, and we shall do our best to comply with your wishes.

CROP REPORT

Four new projects and 291,066 acres were added to the irrigated service area of Federal Reclamation projects in 1956, bringing the total area subject to irrigation service to 7,658,801 acres.

The area irrigated in 1956 was 6,400,143 acres from which 6,263,852 acres of crop were harvested.

Crop harvests in 1956 were valued at $951.6 million, a greater value than ever before reported from Reclamation projects. This represented an average value of $148.69 per irrigated acre. Most crop prices were higher than in 1955 and the general rise in prices received for farm products added $78.3 million to the crop value.

Crop yields were also generally higher, carrying total production to new records. The long term upward trend in crop yields was continued and has resulted in the following improvements since 1940: Corn, 100 percent; onions, 53 percent; cotton, 50 percent; barley, 43 percent; and potatoes, 36 percent.

Forage crops were produced on 46.9 percent of the net area irrigated on all Reclamation projects, and 24.3 percent of the irrigated lands were utilized in producing cereals. The crops within these two groups, totaling more than 15.4 million tons, are utilized principally as livestock feeds, generally in the local areas of production.

Over 5.9 million tons of fresh vegetables, fruits, and nuts were produced from 739,782 acres of irrigated lands in 1956, and dry miscellaneous food crops such as dry beans, sugar beets, mint, hops, etc., totaling over 6.5 million tons were produced from almost 666,000 acres.

Following the pattern of the past, cotton was the most highly valued crop harvest, followed by alfalfa, potatoes, and sugar beets. These crops, along with grapes, wheat, lettuce, apples, and pasture, constituted 60 percent of the total value of the Reclamation harvest in 1956. Data on crop production by crop groups follow:

Crop group	Irrigated crops		Gross crop value	
	Acres	Percent of total	Dollars	Percent of total
Cereals	1,560,894	24.39	103,740,325	10.90
Forage	3,001,023	46.89	180,814,785	19.00
Field crops, miscellaneous	1,115,178	17.42	265,202,730	27.87
Seeds	278,198	4.35	30,748,600	3.23
Vegetables	466,518	7.29	179,160,636	18.83
Fruits and nuts and miscellaneous	295,819	4.62	165,831,115	17.42
Other [1]			26,125,465	2.75
Total reported	6,717,630	104.96	951,623,656	100.00
Less: Multiple cropped	453,778	7.09		
Plus: Soil-building crops	14,623	.23		
Cropland not harvested	121,668	1.90		
Total	6,400,143	100.00	951,623,656	100.00

[1] Additional revenues from Federal and commercial agencies.

A dollarwise evaluation fails to fully appraise the importance to the Nation's health and welfare of the $336 million worth of fresh fruits, vegetables, and nuts grown under Federal irrigation in 1956. These protective and body-building foods and the products were made available by irrigation of our many acres of special climate and soil resources in the West, the duplication of which would be practically impossible elsewhere in the country.

More than 2.5 million persons received irrigation, municipal, and industrial water service through project facilities in 1956. Half a million of these people live on the 134,000 farms which the projects serve. A growing rate of urbanization of farmlands is thought to be revealed in the 1956 data.

The Reclamation sugar beet crop provides 22 percent of the Nation's sugar supply. Irrigation of the sugar beets on Federal projects sets the pace for yields throughout the country. In 1956 Bureau projects produced some 2 billion pounds

of sugar. Irrigation thus plays a highly strategic role in national security by its contribution of this important food crop.

The 77 Reclamation irrigation projects, located throughout the 17 Western States, are divided into 7 regions for administrative purposes. States located mainly within each region are as follows: Region 1—Washington, Oregon, Idaho, and Western Montana; Region 2—California, except southern portion; Region 3—Arizona, Southern California, and Southern Nevada; Region 4—Nevada, Utah, Western Colorado, and Southwestern Wyoming; Region 5—Texas, New Mexico, Oklahoma, and Southern Kansas; Region 6—Eastern Montana, North Dakota, South Dakota, and Northern Wyoming; Region 7—Eastern Colorado, Nebraska, Northern Kansas, and Southeastern Wyoming.

Region 1, with 2,265,209 acres of irrigated lands, the largest in area irrigated of the seven Bureau Regions, produced crops valued at $269 million. This Region contains 35 percent of the irrigated lands and accounted for 28 percent of the total value of crops produced on all Reclamation projects in 1956. Region 3, with less than half as much irrigated land as Region 1, produced crops valued at $233 million, or 24 percent of the total production from all Federal projects during the same year.

Each of the 17 Western States participated in the Reclamation harvest for 1956. Idaho had a larger acreage of irrigated project lands than any of the other States, followed by California, Colorado, Washington, Oregon, Arizona, Nebraska, Utah, and Montana. The gross value of crops produced on Federal projects located in California was higher than for the other Western States; however, the average gross crop value per acre was highest for Arizona, followed by Texas, California, Washington, New Mexico, Oklahoma, etc., respectively. Irrigated acreage and crop value data are presented for each State as follows:

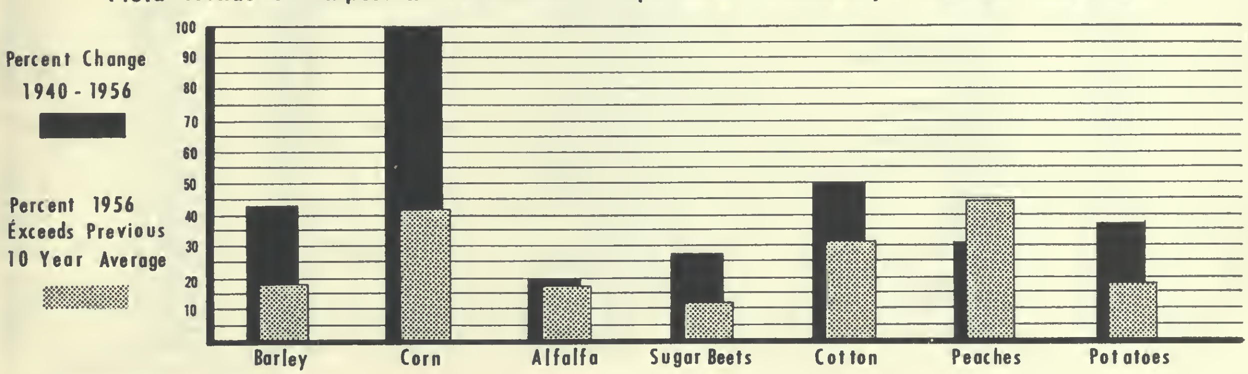
State	Projects or major divisions	Irrigated acreage	Gross crop value	
			Average per acre	Total
	Number	*Acres*	*Dollars*	*Dollars*
Arizona	4	361, 634	298. 55	107, 967, 149
California	6	1, 334, 201	254. 89	340, 072, 542
Colorado	9	790, 845	102. 22	80, 840, 639
Idaho	8	1, 387, 448	89. 40	124, 041, 675
Kansas	1	5, 347	75. 71	404, 812
Montana	11	252, 010	49. 72	12, 529, 580
Nebraska	4	290, 969	98. 47	28, 651, 418
Nevada	3	107, 004	60. 72	6, 497, 442
New Mexico	6	198, 629	174. 18	34, 596, 253
North Dakota	5	26, 939	62. 90	1, 694, 430
Oklahoma	1	39, 296	126. 41	4, 967, 207
Oregon	13	407, 658	112. 51	45, 865, 829
South Dakota	3	71, 915	46. 12	3, 316, 977
Texas	2	63, 125	273. 08	17, 238, 242
Utah	9	272, 295	73. 88	20, 117, 232
Washington	3	569, 614	192. 82	109, 831, 715
Wyoming	5	221, 214	58. 72	12, 990, 424
Total	93	6, 400, 143	148. 69	951, 623, 656

The cumulative value of all Reclamation harvests has reached $12.3 billion. This cumulative value appears to be growing at the rate of 50 percent each 5 years with an indicated tendency toward an even greater rate of growth.

Continuing the watchful appraisal of the Nation's decreasing margin of agricultural potential it appears that current agricultural imbalances will soon disappear in the advance of population growth. Irrigable land loss is occurring at the rate of 1 million acres per year and population is growing at the rate of 3 million a year. The role that the reclamation of arid lands contributes to cushion the inevitable effect of these converging forces should be increased before the time of ultimate need. The country need not follow in history the countless procession of broken nations which, once wealthy and opulent, failed to heed the counsel of those who advised action before the crisis appeared.

# # #

Yield Trends Of Important Reclamation Crops Have Consistently Increased Since 1940



SHOWERS FOR YOUR HOGS MAY SAVE YOU MONEY

Showers for hogs on their way to market may be good for your bankroll as well as for the animals, Agricultural Marketing Service says. Tests are still underway.

Agricultural Marketing Service transportation specialists testing a new built-in shower for trailer-trucks used in transporting hogs to market found that hogs hauled in these trucks maintained their weight much better in hot weather. And none in the sprinkled trucks died, while six died in the unsprinkled trucks.

Under present conditions, hog weights are apt to shrink as much as 4 percent en route to market. In a normal truckload of 22,000 pounds, this can mean from 700 to 800 pounds of meat lost—and money was spent putting those pounds on the animals.

In addition, more than $4 million worth of hogs arrive dead at United States market every year under today's conditions.

In a series of 16 tests with the new and inexpensive device, this is what AMS found:

Two trailers were used in each test in a 330-mile run which lasted over 11 hours. Each trailer had an average load of 110 hogs. In one trailer, there was no change from current conditions. In the other, the driver used the device to give his hogs a 21-minute shower immediately before departure. In addition, he made four 10-minute stops en route and showered the animals at each stop.

It wasn't difficult. The driver simply used a galvanized pipe and a water faucet. A fine mist spray then refreshed the hogs without ruining the sawdust which had been used as litter.

At each stop, the sprinkled hogs appeared more comfortable. They were quieter. They reclined more and foamed less at the mouth.

The spray had a direct cooling effect on the animals. The water moistened the sawdust, and the hogs cooled themselves by lying down on the bedding. The air inside the sprinkled trailers averaged 3.4° F. cooler than the air inside the unsprinkled trailers.

On this series of trips 6 dead hogs were found in the unsprinkled trailers. All the hogs in the sprinkled trailers were alive.

The average weight loss per trip in the unsprinkled trailers was 724 pounds, or 3.3 percent. The sprinkled hogs lost, on the average, only 498 pounds, 2.27 percent.

Finally, sprinkled hogs yielded a higher slaughtered "hot weight," averaging nearly half a pound per animal. In the average trailer load, this made a difference of 103 pounds which would otherwise have been lost. # # #

Water Stored in Western Reservoirs

Operated by Bureau of Reclamation or Water Users except as noted

Location	Project	Reservoir	Storage (in acre-feet)		
			Active capacity	Aug. 31, 1956	Aug. 31, 1957
Region 1	Baker	Thief Valley	17,400	(1)	(1)
	Bitter Root	Lake Como	34,800	8,300	6,700
	Boise	Anderson Ranch	423,200	375,100	312,900
		Arrowrock	286,600	29,200	22,700
		Cascade	654,100	356,600	458,500
		Deadwood	161,900	129,000	121,800
		Lake Lowell	169,000	37,400	18,800
	Burnt River	Unity	25,200	7,900	5,000
	Columbia Basin	F. D. Roosevelt	5,220,000	5,221,000	4,914,000
		Equalizing	761,800	764,500 N	649,600
		Potholes	513,000	174,800 N	146,200
	Deschutes	Crane Prairie	55,300	32,000 N	(1)
		Wickiup	187,300	115,000 N	69,000
	Hungry Horse	Hungry Horse	2,982,000	3,011,100 N	(1)
	Minidoka	American Falls	1,700,000	867,200 N	553,500
		Grassy Lake	15,200	14,000 N	11,900
		Island Park	127,200	83,500 N	65,400
		Jackson Lake	847,000	527,300 N	663,400
		Lake Walcott	80,000	94,000 N	95,400
	Ochoco	Ochoco	47,500	27,900 N	20,500
	Okanogan	Conconully	13,000	8,500 N	6,300
		Salmon Lake	10,500	10,400 N	(1)
	Owyhee	Owyhee	715,000	468,300 N	484,500
	Umatilla	Cold Springs	50,000	11,100 N	6,400
		McKay	73,800	20,300 N	15,000
	Vale	Agency Valley	60,000	21,000 N	15,200
		Warm Springs	191,000	104,900 N	97,300

Water Stored in Western Reservoirs—Continued

Location	Project	Reservoir	Storage (in acre-feet)		
			Active capacity	Aug. 31, 1956	Aug. 31, 1957
Region 1—Continued	Yakima	Bumping Lake	33, 700	17, 400	14, 800
		Cle Elum	436, 900	309, 100	153, 200
		Kachess	239, 000	186, 900	131, 900
		Keechelus	157, 800	76, 600	35, 400
		Tieton	198, 000	148, 500	71, 900
Region 2	Cachuma	Cachuma Reservoir	201, 800	37, 700	34, 200
	Central Valley	Folsom	920, 300	560, 300	580, 900
		Keswick	20, 000	19, 200	19, 300
		Lake Natoma	8, 800	7, 700	8, 100
		Millerton Lake	427, 800	198, 500	153, 300
		Shasta	3, 998, 000	3, 322, 900	3, 167, 200
		Vermillion	125, 100	(1)	(1)
	Klamath	Clear Lake	172, 300	365, 200	299, 100
		Gerber	94, 300	52, 500	52, 300
		Upper Klamath Lake	524, 800	380, 300	268, 100
	Orland	East Park	47, 900	22, 400	15, 500
		Stony Gorge	50, 000	22, 600	21, 700
Region 3	Boulder Canyon	Lake Mead	27, 207, 000	13, 266, 000	21, 498, 000
	Davis Dam	Lake Mohave	1, 809, 800	1, 314, 000	1, 387, 400
	Parker Dam Power	Havasu Lake	688, 000	651, 000	634, 600
	Salt River	Bartlett	179, 500	6, 000	66, 000
		Horse Mesa	245, 100	204, 000	216, 000
		Horseshoe	142, 800	4, 000	7, 000
		Mormon Flat	57, 900	53, 000	46, 000
		Roosevelt	1, 381, 600	7, 000	30, 000
		Stewart Mountain	69, 800	33, 000	55, 000
Region 4	Eden	Big Sandy	35, 000	11, 000	30, 600
	Fruitgrowers	Fruitgrowers	4, 500	500	2, 100
	Humboldt	Rye Patch	179, 000	43, 400	62, 900
	Hyrum	Hyrum	15, 300	5, 300	5, 500
	Mancos	Jackson Gulch	9, 800	1, 800	9, 400
	Moon Lake	Midview	5, 800	3, 600	4, 400
		Moon Lake	35, 800	4, 700	21, 100
	Newlands	Lahontan	290, 900	208, 200	159, 400
		Lake Tahoe	732, 000	676, 800	632, 400
	Newton	Newton	5, 300	100	600
	Ogden River	Pineview	44, 200	13, 500	28, 200
	Pine River	Vallecito	126, 300	46, 100	107, 900
	Provo River	Deer Creek	149, 700	103, 600	118, 100
	Scofield	Scofield	65, 800	8, 500	41, 700
	Strawberry Valley	Strawberry Valley	270, 000	137, 600	156, 000
	Truckee Storage	Boca	40, 900	21, 100	4, 600
	Uncompahgre	Taylor Park	106, 200	62, 500	108, 000
	Weber River	Echo	73, 900	16, 700	29, 300
Region 5	W. C. Austin	Altus	166, 300	22, 700	104, 000
	Balmorhea	Lower Parks	6, 500	300	1, 900
	Carlsbad	Alamogordo	131, 900	2, 200	60, 600
		Avalon	6, 000	1, 300	(1)
		McMillan	38, 700	16, 000	(1)
	Colorado River	Marshall Ford	1, 835, 300	550, 800	703, 500
	Rio Grande	Caballo	340, 900	5, 700	22, 300
		Elephant Butte	2, 185, 400	39, 000	516, 500
	San Luis Valley	Platoro	60, 000	3, 500	49, 500
	Tucumcari	Conchas [2]	465, 100	87, 400	75, 800
Region 6	Missouri River Basin	Angostura	92, 000	37, 000	69, 400
		Boysen	710, 000	525, 300	543, 000
		Canyon Ferry	1, 615, 000	1, 417, 600	1, 375, 800
		Dickinson	13, 500	3, 700	5, 000
		Fort Randall [2]	3, 900, 000	1, 506, 800	1, 830, 400
		Heart Butte	218, 700	57, 600	65, 700
		Keyhole	270, 000	12, 100	1, 700
		Shadehill	300, 000	80, 700	82, 500
	Belle Fourche	Belle Fourche	185, 200	15, 400	37, 600
	Fort Peck	Fort Peck [2]	14, 877, 000	1, 856, 300	2, 840, 200
	Milk River	Fresno	127, 200	82, 000	65, 700
		Nelson	68, 800	39, 900	49, 800
		Sherburne Lakes	66, 100	40, 200	17, 200
	Rapid Valley	Deerfield	15, 100	8, 300	10, 200
	Riverton	Bull Lake	155, 000	124, 400	137, 100
		Pilot Butte	31, 600	12, 000	11, 000
	Shoshone	Buffalo Bill	380, 300	326, 500	322, 300
	Sun River	Gibson	105, 000	46, 000	31, 400
		Pishkun	30, 100	17, 300	7, 700
		Willow Creek	32, 400	23, 800	18, 200
Region 7	Colorado-Big Thompson	Carter Lake	109, 100	19, 100	77, 400
		Granby	465, 600	192, 400	395, 300
		Green Mountain	146, 900	134, 300	146, 300
		Horsetooth	141, 800	39, 200	94, 200
		Shadow Mountain	1, 800	1, 100	1, 300
	Missouri River Basin	Bonny	39, 900	37, 400	40, 300
		Cedar Bluff	176, 800	77, 600	198, 100
		Enders	36, 000	29, 500	30, 500
		Harry Strunk Lake	33, 900	18, 400	34, 100
		Swanson Lake	116, 100	65, 300	111, 700
	Kendrick	Alcova	30, 300	20, 600	27, 500
		Seminoe	993, 200	374, 800	977, 400
	Mirage Flats	Box Butte	30, 400	5, 300	13, 200
	North Platte	Guernsey	44, 200	21, 800	26, 800
		Lake Alice	11, 400	3, 800	3, 400
		Lake Minatare	57, 800	6, 500	31, 200
		Pathfinder	1, 010, 900	33, 600	224, 300

[1] Not reported.
[2] Corps of Engineers Reservoir.

IRRIGATION IN THE MIDWEST

(Continued from page 83)

years. The sheer threat of inadequate water—that is, the mere uncertainty connected with lack of irrigation—undoubtedly has held planting and fertility practices below optimum levels. Several observers report that installation of irrigation equipment usually should be accompanied by a 50 to 100 percent boost in fertilizer application in order to utilize soil potentialities most fully. "For best results, fertility, water, and plants per acre should all be high."

In view of the results obtained through irrigation, it may seem surprising that the practice is not already more widespread in the Midwest. Undoubtedly part of the explanation is provided by the cost of the necessary equipment. Pump, pipe, and sprinklers cost from $40 to $80 per acre irrigated, depending on the location of the water supply, the layout of the fields and the farmer's taste in machinery.

The cost of obtaining the water supply is even more variable. Irrigation requires a lot of water; almost 30,000 gallons are needed to cover 1 acre with 1 inch of water. Sprinkler systems in this region vary considerably in capacity, squirting

ROBERT BROWN adjusting sprinkler head on his system.

from 200 up to 1,500 gallons per minute. At the rate of 500 per minute it takes about 1 hour actual sprinkling time to cover an acre with an inch of water.

Sometimes the water is secured from streams that flow throughout the year, and sometimes small reservoirs are constructed to impound surface runoff in rainy seasons. Frequently shallow

Six-inch aluminum pipe in 20-foot lengths is used for sprinkler line. Two men move one-half mile of pipe from one setup to another in approximately 50 minutes, moving two joints at a time.

wells or sump holes are dug near creeks to utilize both surface runoff and underground water. Where the flow from these holes is small, the water is pumped into reservoirs over a period of time with the supply being drawn down when irrigation is necessary. Other systems rely exclusively on underground water, although some of them also utilize small reservoirs for storage.

Most of the Seventh District is underlaid by water-bearing strata yielding more than 50 gallons per minute to individual wells of suitable depth and dimensions. Moreover, the ground water level is close to the surface in the Midwest compared with the West where deep wells are also used to some extent to provide irrigation water. Some Midwest farms have underground supplies capable of yielding more than 800 gallons per minute from a single well. It is the judgment of authorities that irrigation as currently practiced in the Midwest is feasible for a high percentage of farms in this region.

If the required water can be secured from a stream, pond, or shallow well, the cost of securing the supply may be relatively low. However, the costs mounts rapidly if a deep well with a wide bore, sometimes up to 3 feet in diameter and several hundred feet deep, is required. A deep well may cost $5,000 or more. It behooves a farmer to seek technical advice before having such a hole drilled; its particular location can make a lot of difference in the cost. Also, the water laws should be investigated before a large investment is made in an irrigation system. Although these laws are quite indefinite in most Midwest States, in general they prohibit one user from interfering with normal uses of other users.

Complete sprinkler systems—water supply plus distributing equipment—require an investment of

from $40 to $200 per acre, with the average around $90 in the Midwest, according to a company which fabricates and installs the equipment.

Various authorities are pretty well agreed on the annual cost of operating sprinkler system. Iowa State College places the figure between $20 and $30 per acre. A company that sells the apparatus estimates average annual cost per acre for a typical installation in this region as follows:

Interest cost	$4.50
Insurance and taxes	.45
Depreciation	6.00
Electric energy for power	4.00
Labor	8.00
Maintenance	3.00
Total annual cost per acre	$25.95

Although such an addition to production costs is sizable indeed, the profitability of installing a system must be appraised in view of the additional output and revenue that can be obtained through use of the practice. Assuming that over a number of years corn yields can be boosted an average of 40 bushels per acre (using the figure reported in the Iowa test results) and further assuming that the corn can be sold for an average price of $1 per bushel, the additional revenue produced by the innovation would amount to $40 per acre, $24 in excess of the added cost. Under these circumstances, the investment would pay for itself in 4 years. This probably explains why the use of irrigation is expanding rapidly in the Midwest despite the large investment and high annual operating cost associated with it.

Man's never-ending quest to control and improve his environment has led to a continual succession of technological advances in methods of agricultural production. Successful innovations involve the altering of methods of production in such a way that the average cost of production is reduced. Income is improved for at least those farmers who adopt the usage reasonably early in the process. As the process comes into general use and the price of the product declines, the benefits tend to accrue to consumers and the whole economy shares in the gains.

Sprinkler irrigation is one of the more spectacular innovations that have been added recently to the tool kit of farming practices in this region. However, the economic effects of a widespread adoption of irrigation probably would be similar to those following most other improvements in farm technology.

The size of the individual farm business would be expanded, although in this case not necessarily the acreage. Capital investment per acre (and labor too) would be increased, and farm production would depend to an even greater extent on purchases of nonagricultural materials and services. The organization and operation of a farm business would become even more complex and difficult, and the premium on good management would be widened even further.

Because of the larger investment required to obtain an efficient farm business, fewer people who desired to obtain such a unit would be able to do so out of their own funds. Consequently, the demand for farm credit probably would expand further. Additional operating credit might also be needed to finance the higher annual outlays associated with use of the equipment.

Part of the uncertainty associated with vagaries of weather would be eliminated and total farm production would be boosted. The larger supply would tend to depress prices, but the average cost of producing a bushel of corn would be reduced for those farms which irrigated successfully. For tracts on which cost dropped more than price, land values would tend to rise especially if permanent installations like wells and reservoirs were incorporated into the real estate. Level land with easily accessible water supplies might rise in value prior to the installation of irrigation facilities, merely in anticipation of their future use.

For the most part, these economic effects would be extensions of current trends. However, if irrigation is widely practiced in this region—and the usage is spreading rapidly at this time—those trends may be significantly accelerated. # # #

ANDREW CARLSON checks pressure reading on sprinkler lateral irrigating alfalfa.

C. H. SPENCER SUCCEEDED BY B. P. BELLPORT

Reclamation Commissioner W. A. Dexheimer recently announced the retirement of Regional Director Clyde H. Spencer, with headquarters at Sacramento, Calif. At the same time, he announced the appointment of Bernard P. Bellport as his successor. Mr. Bellport, at the time of his appointment, was construction engineer on the Solano Project in California.

Commissioner Dexheimer acceded to Mr. Spencer's request for retirement after 38 years of continuous service with the Bureau of Reclamation. It became effective September 15.

"We are reluctant to see Mr. Spencer leave the Bureau of Reclamation," Commissioner Dexheimer said. "He has made an outstanding contribution to Reclamation, not only in a long career as a construction engineer but during 4 years of administrative service as the Director of Region 2. However, Mr. Bellport has had 21 years of service with the Bureau and is well qualified to succeed to this important position."

Region 2 comprises the Central Valley of California and coastal drainage basins extending as far north as the Klamath Project on the California-Oregon border.

Mr. Bellport, a 50-year-old native of La Crosse, Kans., is a graduate of the Colorado School of Mines and has been with the Bureau of Reclamation since 1936. His entire Bureau career has been devoted to work on the Central Valley Project until 1952, when he became construction engineer in charge of the Solano Project, which is also located in the Central Valley. He was construction engineer for the Delta-Mendota Canal and the Tracy Pumping Plant of the Central Valley Project immediately prior to the Solano Project assignment. He received a superior accomplishment award in 1951 for his work on the Central Valley Project.

Virtually Mr. Spencer's entire career up to his appointment as Regional Director, in 1953, was devoted to construction projects. He was construction engineer for the Hungry Horse Dam on the South Fork of the Flathead River in Montana, from 1947 to 1953. Under his supervision, this third highest and fourth largest concrete dam in the United States was finished well ahead of schedule and well under the cost estimates. Mr. Spencer and his staff were accorded a unit citation for their work on this project. Mr. Spencer has also received the Department of the Interior's Distinguished Service Award.

Mr. Spencer had previously been on Bureau of Reclamation construction jobs in Utah, Idaho, Oregon, and Colorado. # # #

SIXTEEN FARM UNITS ON WELLTON-MOHAWK DIVISION, GILA PROJECT, TO BE SOLD BY RECLAMATION

Sixteen full-time farm units totaling 2,903 acres will be sold by the Bureau of Reclamation on the Wellton-Mohawk Division, Gila Project, Arizona, Secretary of the Interior Fred A. Seaton recently announced.

Veterans will have preference in applying for all units not allotted to exchange applicants under the act of August 13, 1953. Applicants should apply to the Bureau of Reclamation office at Yuma, Ariz. The filing period for receiving applications closes at 2 p. m. (MST) November 27, 1957.

Commissioner of Reclamation W. A. Dexheimer said that the farm units to be sold are in the fertile Gila Valley, ranging from 28 to 60 miles east of Yuma, Ariz. Irrigation water to serve the land is diverted from the Colorado River at Imperial Dam, northeast of Yuma, and flows through the Gila Gravity Main Canal before entering the Wellton-Mohawk Canal System.

The farms range in size from 115 to 163 irrigable acres and will be sold at prices varying from $496 to $787 per farm, depending on improvements, size of unit, and the classes of land contained therein.

To be eligible for the purchase of a farm unit, applicants must have had 2 full years of farm experience after the age of 15, or have educational or vocational experience which can be substituted for a maximum of one of the years of farm experience, and must meet certain other qualifications of character and industry. Applicants also must possess $5,000 in excess of liabilities. This capital requirement may be in cash or other assets available for development of the farm unit.

Exchange applicants are exempt from these requirements.

An examining board comprised of local agriculturists will review the qualifications of applicants according to the priority established in a drawing to be held shortly after the close of the simultaneous filing period. The farms then will be offered for sale to the qualified applicant in the order of their priority.

Veterans who are given preference in applying for farm units must have served for a period of at least 90 days in the Armed Forces since September 16, 1940, and must have been honorably discharged.

# # #

BOOKS

ROADS, RAILS, AND WATERWAYS

by Forest G. Hill

The United States emerged from the War of 1812 with half a continent to conquer and half a century of peace in which to do it. The only thing that stood in the way was a lack of transportation facilities, and this deficiency could only be corrected by a combination of labor, capital, and the one service no private source could provide—engineering skill. Private industry could supply the first two factors, but the critical skill came from the Engineer Department of the Federal Government.

As part of the War Department, the Engineer Department—including the Corps of Engineers, the Topographical Engineers, and West Point—served as the Nation's department of public works and its chief technical agency. It explored the West, surveyed for roads, canals, and railroads, lighthouses, and other public works, and made the United States Military Academy the Nation's first, and for several decades its leading, engineering school.

These Army engineers, who for decades had a near monopoly of this technical skill and who played such an effective role in promoting the westward movement, have been generally ignored by historians up to the present. Forest G. Hill presents in this book a full picture of their many, varied, and crucial activities between 1815 and the Civil War. It will interest students of economic history, military history, and the history of transportation and the westward movement, as well as the general reader.

University of Oklahoma Press, Norman, Okla.

WATER TREATY VOLUME AVAILABLE

A book entitled "DOCUMENTS on the USE and CONTROL of the WATERS of Interstate and International Streams: COMPACTS, TREATIES, and ADJUDICATIONS," has been published by the Government Printing Office.

This volume, edited by T. Richard Witmer, Office of the Solicitor, Department of the Interior, is the first complete collection of such Compacts, including decisions of the Supreme Court in the field of interstate and international water rights ever published.

Copies may be purchased from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., for $2.

LETTERS

HUMID STATES FARMERS

Dear Sirs: I have just read with much interest the May 1957 issue of "The Reclamation Era" and particularly the article by Mr. W. J. Liddell, Vice President, Dixie Irrigation Co., Memphis, Tenn., entitled "Humid States Farmers Discover Irrigation."

If entirely agreeable with you and Mr. Liddell, to whom I am furnishing copy of this letter, I would like the privilege of reproducing this article in our Atlantic Coast Line Agricultural and Livestock Topics, which is a monthly paper mailed without charge.

Your early advice will be very much appreciated.

Yours very truly,

/s/ A. R. Howard,
General Agricultural and Livestock Agent, Atlantic Coast Line Railroad Co., Wilmington, N. C.

Reprint permission was gladly granted. —Ed.

MAJOR RECENT CONTRACT AWARDS

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DC-4898	Collbran, Colo	July 12	Construction of Vega Dam and relocation of county road	C. F. Lytle Co., Sioux City, Iowa.	$1,707,145
DC-4901	Weber Basin, Utah	do	Construction of Willard dike, levee, and access road, Schedule 1.	Jack B. Parson Construction Co., Smithfield, Utah.	349,400
DC-4910	Grants Pass, Oreg	Sept. 10	Construction of fish screen structure for Savage Rapids Dam	Peter Kiewit Sons' Co., Medford, Oreg.	126,452
DC-4912	Colorado River Storage, Arizona-Utah.	Aug. 8	Construction of sewage treatment plant for Page, Ariz	W. W. Clyde & Co., Springville, Utah.	221,445
DC-4918	Ventura River, Calif	Aug. 20	10 horizontal, centrifugal-type pumping units for Ventura Avenue pumping plants Nos. 1 and 2 and Ojai Valley pumping plant, Schedule 1.	Food Machinery & Chemical Corp., Peerless Pump Division, Indianapolis, Ind.	212,206
DC-4922	Middle Rio Grande, N. Mex.	July 31	Construction of earthwork, clearing, and structures for irrigation rehabilitation, Belen Unit 3.	Badger Lynch, Albuquerque, N. Mex.	142,283
DC-4924	Colorado River Storage, Arizona-Utah.	Aug. 22	Construction of field laboratory building, municipal building, and warehouse for Page, Ariz.	Security Construction Co., Salt Lake City, Utah.	358,709
DC-4927	Weber Basin, Utah	Aug. 16	Construction of earthwork, pipelines, and structures for trunkline 10.0 (West Farmington) and trunkline 18.8 (Woods Cross), Davis aqueduct.	Thayn Construction Co., Salt Lake City, Utah.	585,273
DC-4928	Columbia Basin, Wash.	Sept. 16	Enlargement of Potholes East canal, Sta. 299+40 to 376+32, Schedule 3.	Peter Kiewit Sons' Co., Vancouver, Wash.	209,755
DC-4928	do	Sept. 18	Enlargement of Potholes East canal, Sta. 770+00 to 1157+02, Schedule 6.	Arthur R. Sime, Kennewick, Wash.	302,967
DC-4932	Middle Rio Grande, N. Mex.	Aug. 20	Construction of earthwork, clearing, and structures for irrigation rehabilitation, Belen Unit 4.	Boswell Construction Co., Albuquerque, N. Mex.	167,955
DC-4933	Colorado River Storage, Arizona-Utah.	Sept. 10	Construction of water-supply system for Page, Ariz	Southern Engineering & Construction Co., Inc., Long Beach, Calif.	1,054,694
DC-4934	Missouri River Basin, Nebr.	Aug. 22	Construction of earthwork and structures for Driftwood canal, Sta. 812+17 to 1563+15; Driftwood subcanal, Sta. 0+00 to 293+78; Driftwood subcanal lateral system and drains.	Bushman Construction Co., St. Joseph, Mo.	1,374,034
DC-4936	Shoshone, Wyo	Sept. 6	Construction of left abutment outlet works and rehabilitation of penstock intakes for Buffalo Bill Dam.	Long Construction Co., Inc., Billings, Mont.	680,460
DC-4937	Ventura River, Calif	Sept. 11	Construction of Robles diversion dam and Robles-Casitas diversion canal, utilizing precast-concrete pipe in 78-inch diameter siphon, Schedule 2.	M. H. Hasler Construction Co. and F. W. Case Corp., Los Angeles, Calif.	1,531,599
DC-4938	Missouri River Basin, Mont.	Sept. 18	Construction of earthwork and structures for Helena Valley canal, Sta. 626+63.52 to 1842+69.05.	Cherf Bros., Inc., and Sandkay Contractors, Inc., Ephrata, Wash.	947,885
DC-4943	Columbia Basin, Wash.	Sept. 27	Construction of earthwork, concrete canal lining, and structures for Wahluke Branch canal, Sta. 171+13.4 AH to 333+20.	Thompson Construction Co. and George W. Lewis, Kennewick, Wash.	613,028
DC-4944	Middle Rio Grande, N. Mex.	Aug. 29	Rehabilitation of Angostura diversion works	Crocker Construction Co., Denver, Colo.	125,704
DC-4949	do	Sept. 20	Construction of earthwork, clearing, and structures for irrigation rehabilitation, Belen Unit 5.	C. R. Davis Contracting Co., Albuquerque, N. Mex.	213,464
DC-4955	Central Valley, Calif	Aug. 30	Furnishing and installing armature winding for generator unit No. 5 at Shasta powerplant.	General Electric Co., Denver, Colo.	220,000
100C-299	Minidoka, Idaho	July 24	Completion work for 57 wells, Groups 5, 6, and 7	Electric Pump & Equipment Co., Inc., Twin Falls, Idaho.	193,880
117C-430	Columbia Basin, Wash.	July 9	Construction of two 3-bedroom residences, one 2-car garage, pumphouse, storehouse, shop and office for Burke Watermaster headquarters and Block 77, Schedules 3 and 4.	Pete Winter, Builder, Ephrata, Wash.	116,949
117C-437	do	July 12	Construction of deep drains DE49 and tributaries, Block 43	Utility Construction Co., Ontario, Oreg.	112,340
117C-454	do	Sept. 5	Construction of earthwork, concrete lining, and structures for Block 401 laterals and wasteways, East Low canal laterals.	Duncan Construction Co., Moses Lake, Wash.	139,858
400S-86	Colorado River Storage, Arizona-Utah.	July 17	Liquefied petroleum (propane) gas service, including furnishing and installing storage tanks and piping, for Page, Ariz.	Petrolane Gas Service, Inc., Long Beach, Calif.	155,725

Construction and Materials for Which Bids Will Be Requested Through December 1957*

Project	Description of work or material
Central Valley, Calif.	Constructing about 12.5 miles of 12- to 45-inch concrete pipelines, 2 pumping plants and appurtenant structures, for the Southern San Joaquin Municipal Utility District, Unit 1 Extensions, near Delano.
Colorado River Storage, New Mexico.	Furnishing and erecting a prefabricated metal building for use as a garage, fire station and warehouse, at the Navajo Dam Government Community, about 39 miles east of Farmington.
Colorado River Storage, Utah.	Constructing a 105- by 36-foot wood-frame administration building, a 54- by 39-foot wood-frame laboratory, a 100- by 30-foot concrete masonry garage and fire station, and a 60- by 24-foot wood-frame conference hall, at the Flaming Gorge Community, about 16 miles southeast of Linwood.
Do	Constructing a water supply system for the Flaming Gorge Community.
Columbia Basin, Wash.	Constructing 6,100 feet of open ditch drains and wasteways, modifying structures, and deepening 2,600 feet of W38 wasteway, in Block 72, southeast of Quincy.
Columbia Basin, Wash.	Earthwork and structures for a 5,300-cfs-capacity, 8-foot bottom width, concrete-lined canal, about 10 miles long, including a radial gate diversion structure, a timber bridge and a 2,000-foot-long rectangular concrete terminal chute into the Columbia River. Esquatzel Diversion Channel, near Pasco.
Do	Earthwork and structures for about 3,000 feet of 2-foot bottom width wasteway channel, in Blocks 41 and 42, near Moses Lake.
Do	Furnishing and sowing about 350 acres of lateral and wasteway banks in Block 18, west of Connell, and Block 85, northeast of Beverly.
Do	Earthwork and structures for deepening 3.9 miles of open ditch drains, including road and lateral crossings, and removing and/or salvaging concrete and metal pipe, in Block 78, south of Quincy, and earthwork and structures for deepening 6.5 miles of open ditch drains in Blocks 41 and 42, near Moses Lake.

*Subject to change.

Construction and Materials for Which Bids Will Be requested Through December 1957*—Continued

Project	Description of work or material
Columbia Basin, Wash.—Con.	Two motor-driven, horizontal, centrifugal-type pumping units, each with a capacity of 20 cfs at a total head of 102 feet for the initial installation at White Bluff Pumping Plant No. 2.
Fort Peck, Mont., and MRBP, North Dakota.	Clearing rights-of-way, furnishing and installing fence gates, constructing footings, and furnishing and erecting steel towers for about 309 miles of single-circuit, 230-kv transmission line from Fort Peck Power plant, near Fort Peck, through the Dawson County Substation, near Glendive, Mont., to the substation at Bismarck, N. Dak.
Gila, Ariz	Removing and replacing damaged concrete canal lining and constructing an 80-foot-wide reinforced concrete overchute, 180 feet long, across the Wellton-Mohawk Canal, near Yuma.
Middle Rio Grande, N. Mex.	Constructing about 2.5 miles of 250-cfs-capacity canal, including timber bridges, multiplate arch culvert, drainage inlet and concrete drop. Atrisco Feeder Canal (North Reach Extension), north of Albuquerque.
Do	Constructing about 11.5 miles of the Atrisco Feeder Canal road, placing gravel blanket on canal banks, and laying corrugated metal pipe for drain and wasteway inlet structures, near Albuquerque.
Minidoka, Idaho	Riprapping dikes northwest of Rupert.
MRBP, Colorado	Reconductoring about 65 miles of the Greeley-Beaver Creek 115-kv woodpole transmission line. Between Greeley and Brush.
Do	Removing a 6,000-kva transformer, three 115-kva lightning arrestors, and six 115-kv fuse disconnecting switches, and constructing concrete footings, minor steel structures and a 12- by 28-foot concrete block addition to the substation building, and installing a 12,000-kva autotransformer, three 115-kv disconnecting switches, and one 115-kv interrupting switch, and carrier relaying equipment, at the Sterling Substation, at Sterling.
Do	One 8,000/10,000-kva, 110-7.2/12.47-kv, 3-phase power transformer for Loveland Substation, near Loveland.
MRBP, Kansas	Earthwork and structures for about 3.2 miles of 12-foot bottom width unlined canal and about 2.8 miles of 12-foot bottom width compacted earth-lined canal, including concrete check, precast concrete pipe siphons and a drainage inlet. Osborne Canal, near Stockton.
MRBP, Montana.	Earthwork and structures for about 15 miles of unlined open ditch laterals with bottom widths varying from 6 to 3 feet. Spokane Bench Laterals, near Helena.
MRBP, Nebraska.	Constructing 3.2 miles of 440- to 250-cfs-capacity open ditch drains with 4 drop structures, and constructing 4.6 miles of 12- to 6-cfs-capacity open ditch laterals including 13 turnouts and 11 siphons. Near Red Cloud.
Do	Constructing 12 steel pipe and concrete pump turnouts, and earthwork and structures for about 0.9 mile of 3-foot bottom width open ditch lateral extension. Meeker, Cambridge, and Bartley Canals, between Trenton and Edison.
MRBP, Nebraska-Kansas.	Constructing 2 wasteway structures, 3 sheet-pile and riprap drops, 2 baffled-apron drops, 8 pump turnouts, 5 corrugated-metal pipe drainage inlets, about 1.4 miles of open ditch drain with bottom widths varying from 74 to 20 feet, and relocating about 0.25 mile of 3-foot bottom width open ditch lateral. Bostwick Division, between Republic City, Nebr., and Scandia, Kans.
MRBP, South Dakota.	Furnishing and stringing three 954,000 CM ACSR conductors and two 0.5-inch high-strength, steel overhead ground wires for the 67-mile-long, steel tower Utica Junction-Sioux Falls 230-kv Transmission Line, and installing 9 switches at the Utica Junction Tap Station. Between Lesterville and Sioux Falls.
Do	One 8,000-kva, 110 to 41.8-kv, 3-phase power transformer, with load-tap-changing to regulate the low voltage output for Summit Substation.
MRBP, Wyoming.	Two 114-inch butterfly valves for the Fremont Canyon Powerplant. Estimated weight: 270,000 pounds
Do	One 14- by 18-foot fixed-wheel gate for the Fremont Canyon Powerplant. Estimated weight: 112,000 pounds.
MRBP, Wyoming—Con.	Six bulkhead gates, seats, guides and lifting frame for draft tubes for the Fremont Canyon Powerplant. Estimated weight: 38,000 pounds.
Palo Verde Diversion, Arizona-Calif.	Constructing one or two 3-bedroom residences including sewage disposal systems, near Palo Verde Diversion Dam, northeast of Blythe.
Riverton, Wyo	Earthwork and structures for 4.9 miles of closed drain on the Wyoming Canal. About 25 miles northwest of Riverton.
Rogue River Basin, Oreg.	One 13,500/18,000-kva, 4.16/69-kv, 3-phase power transformer for the Green Springs Powerplant.
Solano, Calif	Earthwork and structures for about 8.7 miles of the 7-foot bottom width concrete-lined Putah South Canal, including monolithic concrete box siphons, precast concrete pipe siphons, turnouts, checks, culverts and bridges. Near Fairfield.
Ventura River, Calif.	Furnishing and erecting 5 circular steel tank reservoirs or constructing 5 circular prestressed concrete reservoirs ranging from 250,000 to 3,500,000 gallons, near Ventura.
Do	Clearing about 1,900 acres of trees and brush, and removing fences and buildings from the Casitas Reservoir site, near Ventura.
Do	Construction 5 outdoor-type pumping plants including control buildings with concrete masonry unit walls and roofs of metal joists with wood decks and built-up roofing to house the electrical control equipment. Work will include installing electrical control cubicles and the following electrically driven horizontal pumping units at each plant: 4 of 50-cfs total capacity for Ventura Avenue No. 1 Pumping Plant, 3 of 48-cfs total capacity for Ventura Avenue No. 2 Pumping Plant, 3 of 20.7-cfs total capacity for Ojai Valley Pumping Plant, 2 of 8.2-cfs total capacity for Upper Ojai Pumping Plant, and 2 of 6.4-cfs total capacity for Rincon Pumping Plant. North of Ventura.
Wapinitia, Oreg	Constructing the 57-foot-high earthfill Wasco Dam, containing about 50,000 cubic yards of material, with crest length of 370 feet, and appurtenant structures. On Clear Creek, about 35 miles west of Maupin.
Washita Basin, Okla.	Constructing the 101-foot-high Fort Cobb earthfill dam, including spillway and outlet works and constructing about 2,400 feet of access road and improving about 3,200 feet of county road. On Pond Creek, north of Fort Cobb.
Weber Basin, Utah.	Earthwork and structures for about 15 miles of Uintah Bench Laterals of precast concrete pipe, modified prestressed steel cylinder pipe, mortar-lined and coated steel pipe and cast iron pipe or asbestos-cement pipe: 2 small reservoirs; and one pumping plant with 4 outdoor, horizontal booster units. South of Ogden.
Do	Constructing 4 pumping plants consisting of 2 outdoor, sump-type plants of 8- and 13-fcs capacities, an outdoor, flat-slab-type plant of 4-cfs capacity: and an indoor-type plant of 5-cfs capacity. Work will also include constructing about 4 miles of 15- to 36-inch reinforced concrete, pretensioned reinforcement (steel cylinder type) pipe, discharge lines, and trunklines. Sand Ridge, East Layton and Val Verde Pumping Plants, between Salt Lake City and Ogden.
Do	Constructing 6 concrete stream measuring controls on the Ogden River and its tributaries, east of Ogden.
Do	Constructing recreational facilities including access roads, culinary water system, irrigation ditch, boat ramp, fireplaces, shelters, restrooms and landscaping at the Wanship Reservoir area, 38 miles east of Salt Lake City.
Do	Constructing two 6-room brick veneer residences with floor spaces of about 1,180 square feet, full basements and a double garage, at the Gateway Powerplant, southeast of Ogden.
Yakima, Wash	Earthwork and structures for 7,880 feet of 8- and 10-inch asbestos cement pipelines. Work will include jacking 43 linear feet of 30-inch corrugated metal pipe under railroad. West of Kennewick.
Do	Jacking 84 linear feet of 30-inch corrugated metal pipe under railroad, about 10 miles west of Kennewick.

*Subject to change.

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Fred A. Seaton, Secretary

Bureau of Reclamation, W. A. Dexheimer, Commissioner

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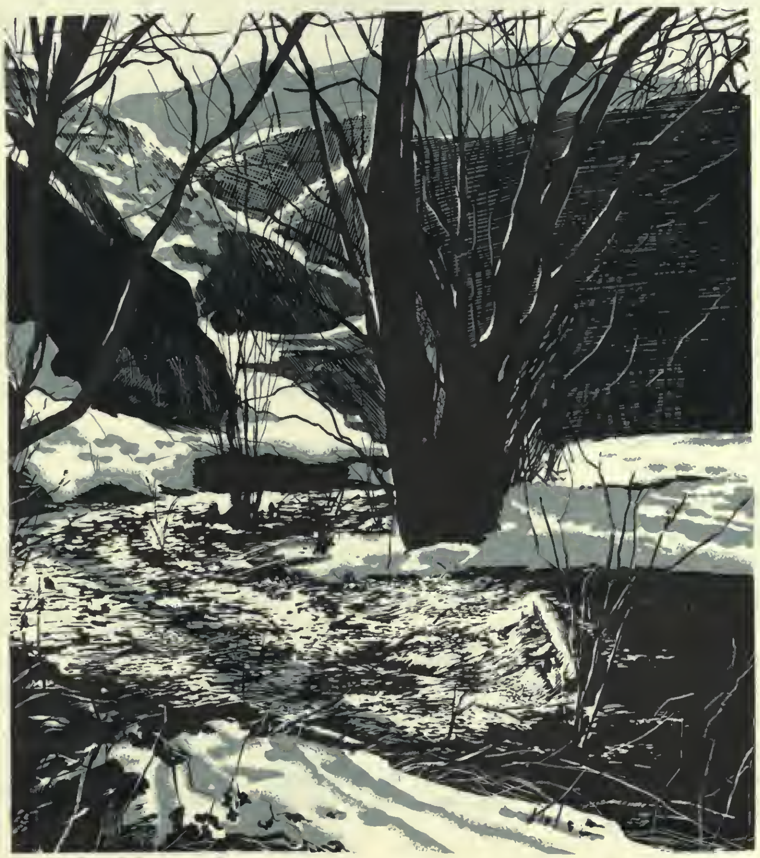
The Reclamation Era

FEBRUARY 1958



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Reclamation and Hurricane Audrey

Audry comes home with a vengeance. She docked herself within a stone's throw of the icehouse.—*All photos by the author.*

That the Bureau of Reclamation, located as it is in the 17 Western States, would play a useful, though somewhat indirect, role in the wake of Hurricane Audrey's attack on Louisiana, may appear a little surprising. Neverthless, such did take place with myself as the "fortunate" participant.

A little background is desirable. Public Law 875, enacted by the 81st Congress, provides for aid by the Federal Government in alleviating suffering and damage and in repairing essential public facilities resulting from major disasters. Recognizing that major disasters cannot be "programed," the law further provides that engineers, health officials, procurement specialists, etc., from Federal agencies may be "drafted" to meet the peak requirements of multiple disasters. In 1953 the Federal Civil Defense Administration was assigned the responsibility of administering Public Law 875, thus placing them in charge of natural disasters (tornadoes, hurricanes, etc.), as well as manmade disasters (wars).

The unprecedented floods last spring in Texas, Oklahoma, Louisiana, and Arkansas highly overtaxed the personnel of the FCDA Regional Office at Denton, Tex. Some 70 engineers from several different Federal agencies were drafted to help in the large task of providing Federal aid. As one of these "draftees," I was on an engineering inspection of damaged public facilities in Arkansas when Audrey hit. The apparent magnitude of Audrey warranted my immediate transfer to Cameron, the heart of the Louisiana coastal

by D. R. CERVIN
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area that was struck. For the next 3 weeks I lived an experience that can never be forgotten, that wouldn't be traded, and that, I hope, never will be repeated.

Before discussing the active work of helping the stricken area, there follows a short review of the geography of the area, the storm, and the broad scope of the damage.

Cameron Parish is the southernmost parish (county) in Louisiana. It is about 75 miles from east to west and averages about 20 miles from north to south. The entire area is predominantly marshy with numerous wildlife sanctuaries.

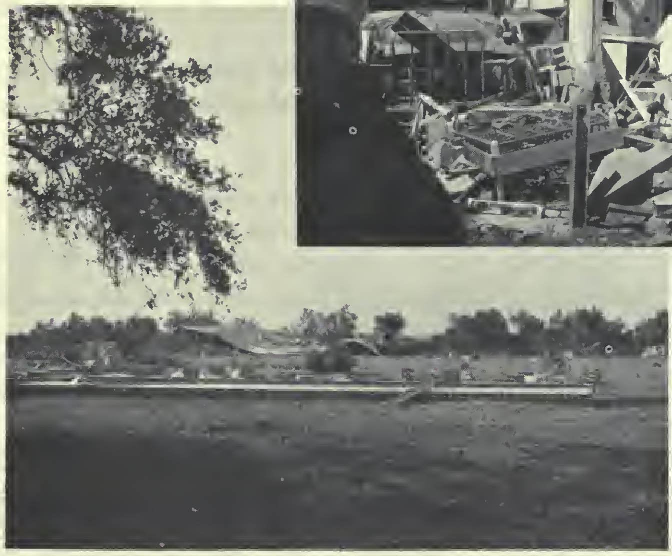
Calcasieu Lake divides the area in an east-west direction with the east area nearly double the west. There are just 2 centers of population: several towns such as Hackberry and Grand Lake in the northern part of Calcasieu Lake, and a continuous strip from the parish seat, Cameron, just south of the lake and near the gulf, to within 7 miles of the east parish boundary. A much lesser number live west of Cameron, principally in Johnson's Bayou and Holly Beach. The population along the coast was reportedly about 4,000. There are about 2,500 elsewhere in Cameron Parish. The entire area is exceedingly low, possibly rarely exceeding 15 feet above sea level. The south half is uniformly lower than the north, most of it only a few feet above high tide. Homes are generally constructed on 12- to 18-inch concrete blocks without further foundation, typical of fishing villages. However, during the past 5 to 6 years considerable prosperity has been enjoyed by the coastal area and many fine brick veneer homes with continuous but shallow footings have been erected.

During early morning of June 27 a record windblown high tide hit the beach just slightly ahead of the hurricane. By 4:30 a. m. water was waist deep in the homes. All who could escaped to the fine modern courthouse which eventually housed close to a thousand people. Many could not get there, and sought refuge in the few two-story houses available, in their attics or on their roofs, tied to sturdy trees, or were just victims of the storm and tried to ride it out on rafts from the broken panels of their homes. Of course, a large number had already evacuated, those staying believing that the storm might not hit until the following day. Audrey reached its peak intensity at 7 a. m. and did not abate until 2 p. m. The water reached a maximum depth at 10 a. m.

The intense damage provoked by Hurricane Audrey was from the eastern edge of Johnson's Bayou to the east part of Grand Chenier, a distance of over 50 miles. Johnson's Bayou is protected by a small rise in elevation; east of Grand Chenier is a swampy area with few inhabitants. Peak damage was done across this entire strip inland to the intercoastal canal, a distance of 12

HOLLY BEACH—This desolate scene is hard to believe. Before "Audrey" there were 32 all-year homes, and 200 beach cabins on this site.

Below: ONE MONTH OLD, $35,000 home. Rupert Doxey's family of five actually rode in this house to the tree line shown in photo during the hurricane. Finally, all 5 tied themselves to adjoining trees and held on for 7 hours until they were rescued.



IMPOSSIBLE for a home to have greater destruction than this? No; over one-third of all homes were reduced to complete rubble, and the resulting debris has been distributed over several hundred square miles of swamps

miles. The damage between the coastal homes and the intercoastal canal was principally confined to cattle losses—some 40,000.

This was one of those rare disasters where the words "100 percent" may be freely used. Close to 100 percent of the structures suffered intense damage; in many cases 100 percent damage. Actually, only the Cameron Courthouse was relatively undamaged, and it had 6 feet of water in the basement. Much incalculable damage was done to records, and several thousand dollars in donated labor and equipment were necessary to clean up and repair the basement. Only a couple dozen homes were fit to live in after the storm, and then only after a large number of people simultaneously moved in and cleaned up. Excluding Cameron, where the many trees and closeness of homes prevented total eradication of any one home, at least one-third of the homes were totally demolished and blown or washed to the intercoastal canal. In Holly Beach every one of the 32 permanent homes and 200 rental cabins have totally disappeared except for bowled-over concrete foundation blocks. The picture on page 2 is a grim reminder of this unbelievable situation.

With such fantastic destruction, where hundreds of homes were torn into shreds, where an entire area 75 miles wide and over 10 miles long was covered with water, generally over a person's head, and where gale velocities around 80 m. p. h., with gusts of 135 m. p. h., raged for nearly 7 hours, it seems almost miraculous that "only" 335 died and 190 are missing. In the words of Val Peterson, "This is the greatest single disaster in terms of death and suffering that I have ever seen."

The first 2 days after the storm were spent almost entirely in rescuing humans and evacuating people. The air fairly buzzed with helicopters and airplanes, every available piece of seaworthy equipment was pressed into service, and marsh buggies charged into the ever dangerous and greatly enlarged swamps on their missions of mercy.

While searching for the living, the grim task of recovering the dead also went on. The first 200 were easily found—they died in their homes, sometimes actually drowned in their attics, were caught in piles of debris, or simply drowned in the new 8-foot sea. But the other 135 repre-

REMNANTS of a well-built brick business building.

sented one of the most intensive body hunts in history. The swamps cover several hundred square miles. With literally millions of broken pieces of debris and thousand of dead cattle piled up in a heterogeneous fashion, it was impossible to even find the bodies except by helicopter. When a body was located a flagged bamboo pole was set as a marker and the bearings and distance from a central point was given to marsh buggy drivers. The difficulty of finding the markers and the 4 to 5 miles per hour maximum speed through the swamps limited body recovery to not over 10 a day. Even this work had to be curtailed after 2 weeks due to the intense activity of heat and salt water on the remains. Without benefit of an organized search, bodies are still being recovered.

The work of the FCDA starts from the time a disaster appears to be of a magnitude great enough to warrant a Presidential declaration of "This is a disaster area," to the final payment for eligible work, in the case of the hurricane possibly 2 years later. The word "eligible" is very important. As already pointed out, the law generally provides for removal of debris of wreckage, elimination of safety and health hazards, and the minimum restoration of public facilities. Within the law itself and later by administrative determination there are many angles and slants to consider regarding what is eligible work. The general rule is this: Public facilities may usually be repaired; however, private property may be worked on only if health or safety factors are involved.

FCDA's "modus operandi" for helping out in a disaster is: "Move in as observers" even before the area is declared a "disaster area," assist the State in determining what the initial request by the governor should be, secure the money from the Federal Treasury and transfer to the State Treasury, prepare or supervise preparation of estimates for eligible work, assist the local government in preparing an application which utilizes these estimates, review and approve these applications which permit the using of a part of the Federal funds, make interim engineering inspections; audit the work, and make final payments for the eligible work.

It is evident that only a small amount of this could be participated in during the 3 weeks spent in Cameron.

My principal assignment during the 3-week detail was in connection with debris and wreckage removal.

The amount of debris scattered in Cameron is hard for one to visualize who has not been there. Even pictures do not do it "justice." One way of describing the scene was that no grass could be seen. So many scores of homes a little south of Cameron were blown into the town area and then torn into panels, pieces, and rubbish by the intensity of Audrey, that nearly all of the grassed areas were covered with wood.

There were two basic conditions that imposed an ultra severe problem, even by major disaster standards, in setting up a construction organization that could efficiently remove debris. Condition 1: Practically every house, structure, and public utility was damaged almost 100 percent; thus is was difficult for natural distaster operators to even find a place to get started. Condition 2: The closest metropolition area, Lake Charles, is

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Destroyed filling station. The stockpile of tires is for burning cattle.

something new in fish protection

by H. W. THOMSON
Chief, Tracy Operations Field Branch,
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Sacramento, Calif.

When the Tracy pumping plant on the Central Valley Project in California was in the design stage, one of the requirements was to provide a fish screen. The fish screen was to protect sport fish, that is, salmon and striped bass, from entering the canal and being destroyed on the farmland to which the water flowed. This sounds easy, and was thought to be a relatively simple problem to solve at the time. However, it did not prove to be easy. The physical situation is that the Tracy pumping plant inlet is at one corner of the delta formed by the Sacramento and San Joaquin Rivers, and during the heavy pumping season, which is also the fish migratory season, most of the channels in the delta have water flowing toward the pumping plant. The fish to be caught are principally striped bass and salmon in the very small fingerling stage. These fish are on their way to the ocean and are consequently drifting downstream and are too small to avoid the entrance to the canal.

Initially, an experimental setup was provided in a temporary bypass canal inlet. This pilot fish screen provided several methods of trapping fish, of which the primary method was to install pipes at intervals along the screen, and as the fish traveled back and forth along the screen they would eventually be sucked in through holes in the pipes and carried to a holding pond. Whenever sufficient fish were on hand, they would be drained into a barge and transported down river to a suitable location and there released.

Other methods, such as various types of traveling screens, were tried, but all of these methods had very little success. Either they did not catch fish or they injured the fish severely.

Finally, the present method was evolved, of which the simplest description is that the structure resembles a venetian blind with the slats, called louvers in this instance, placed vertically in the water instead of horizontally as we normally see a venetian blind. Picture No. 2 shows the final arrangement with the line of louvers running at an angle across the intake canal, four entrance bypasses for fish, and the crane which is used periodically to raise louver sections so that debris may be washed off. The young fish, which incidentally go downstream and out to sea tailfirst, apparently instinctively fear the small ripples caused by the vertical slats since such disturbances are usually caused by rocks upon which they can be left high and dry to perish. Attempting to avoid this disturbance, they exert themselves sufficiently to move along parallel to the row of verti-

General view of holding tanks, secondary louver, and pumping plant areas.—*Photo by E. S. Ensor, Region 2.*

DELTA-MENDOTA CANAL—Side view of trash rake on trash rack structure.—*All photos in this article, except otherwise noted, by J. L. Brown, Region 2.*

cal slats and are carried into 1 of 4 bypasses. The result is that the bulk of the water passes through the slats and on to the pumping plant while that small portion which enters the four bypasses contains a large part of the young fish. The concentration of fish in the bypass pipes is expected to be approximately 40 times greater than the normal concentration in the main channel.

Ahead of the primary louver is a trash rack which prevents floating debris from entering the intake canal. Picture No. 1 shows the operation of a device for removal of this debris, averaging 15 to 18 tons a day. This rake is arranged so that the debris is carried over the top and falls into a dump truck.

The fish, carried through bypass pipes, proceed to two sets of secondary louvers (see picture No. 3). Here they are further concentrated to an expected density of approximately 640 times greater

View of primary louver looking downstream. Hoist is used to raise louvers.

than in the inlet canal and are routed to holding tanks shown in picture No. 4. An additional function of the secondary louvers is to separate the fish from mossy water. Screened moss-free water is introduced along one side of the secondary lover structure. The louvers direct the fish

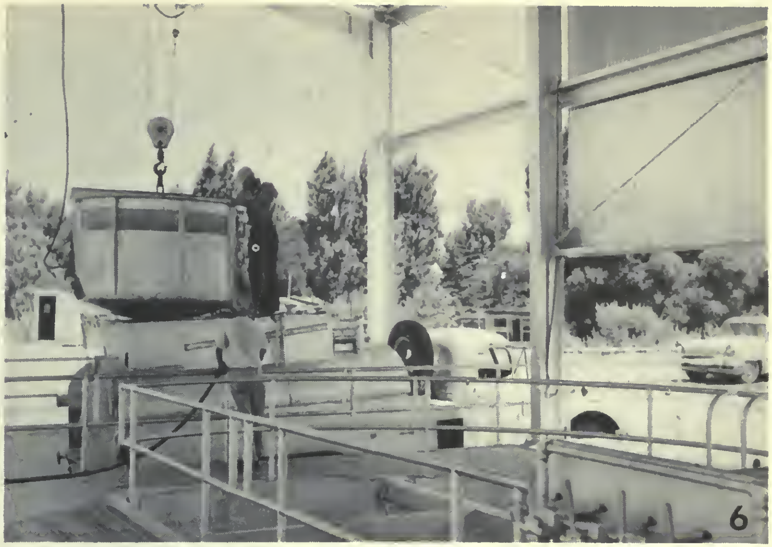
Looking downstream in secondary channel.

into this clean water while the moss-laden water passes through the louvers and is pumped back into the canal.

The holding tanks have a screen that keeps the fish from going out of the tank as the water passes through (see picture No. 5). Approximately 15,000 fish are all that can be held in 1 tank or transported in 1 truckload. When this number of fish has been collected the water is lowered and the bucket shown in picture No. 6 is lowered by a crane to the bottom of the tank as shown in picture No. 5. The screen is raised a few inches and all the fish and the remainder of the water flow into the fish bucket. The bucket is then lifted out of the tank and moved laterally by the same crane to the end of the structure where the contents are released into a tank truck to be carried down the river and released.

Counting of the fish is done by sampling a 5-minute count of the fish every 2 hours. This

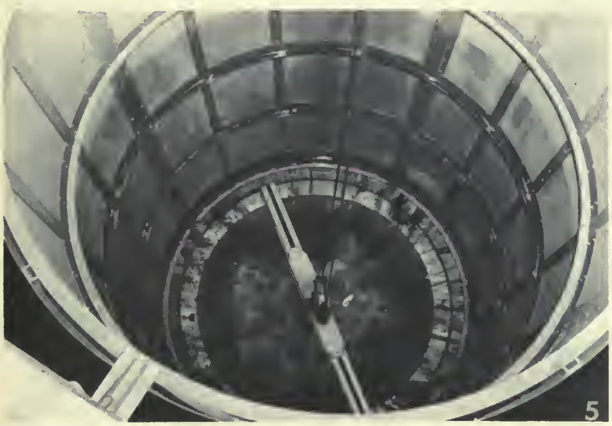
DELTA MENDOTA CANAL—Fish holding tanks.



Fish being loaded into tank truck from fish transporting bucket.

counting is done by putting the 5-minute collection of fish in a small basket as shown in picture No. 7. The fish can then be removed a few at a time, species and number determined, and the fish returned to the tank alive. Picture No. 8 shows more plainly the various sizes of fish and other small debris that are caught.

The new system has been in operation approximately 6 months, and evaluation tests are now in



Fish transporting bucket in position to collect fish in holding tank.

process and will be continued for 2 seasons. No quantitative results are available as yet, but indications are that the new structure and method is many times more effective than any of the previous methods. We have caught as many as 100,000 fish in a day, but since the run of fish peaks rather sharply, the maximum for 1 month so far has been 1,900,000. After the 2-year-test program has been completed and analyzed, any necessary revisions will be added to the present system. Indications are that we have found the most effective fish screen that has yet been devised for saving fingerlings as small as five-eighths inch long.

Because the Tracy fish-collecting facility is a unique structure with no history of experience behind it, its efficiency, both mechanically and biologically, is being carefully evaluated. Here again the Fish and Wildlife Service is participating. The results of the first season's operations, which began in February, are shown in table at end of the article.

Continued on page 19

Making a fish count showing the counting box and net.

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Frank A. Banks Dies

Frank A. Banks, builder of Grand Coulee Dam and other major Reclamation Bureau structures, died on December 14 of a stroke in San Marino, Calif. He was 74.

Mr. Banks, a native of Saco, Maine, started as a $65-a-month survey gang rodman in Montana in 1906 when the Reclamation Bureau was 4 years old.

Commissioner Dexheimer said: "A record of his career is almost a history of reclamation in the Northwest."

Mr. Banks, described as a mild-mannered man, often was offered positions in private industry and with foreign governments at several times his salary with the Bureau. He always turned them down.

Among the dams he helped build were the Jackson Lake Dam on the Snake River in Idaho; the American Falls Dam, also on the Snake River; the Arrowrock Dam, Boise River, Idaho; the Owyhee Dam, Owyhee River, Oreg., and the Thief Valley Dam on the Powder River in Oregon.

In addition to designing the Grand Coulee Dam in Washington, he worked on other features of the vast Columbia Basin project, including the construction of the world's largest pumping plant there.

President Truman in 1950 presented Mr. Banks with the Gold Medal for Distinguished Service, the highest honor of the Interior Department.

He retired in 1950, but continued to serve as an adviser to the Bureau on a number of projects.

Mr. Banks joined the Bureau shortly after graduating from the University of Maine.

Two years ago Mr. Banks was elected an honorary member of the American Society of Engineering. He is survived by his wife and two children. # # #

Left to Right: Mr. A. G. Lucier, Mrs. Ida Schacht, Mrs. Margaret Robinson, Mrs. Lulu Shoemaker, Mr. and Mrs. A. D. Hardy, and Mr. and Mrs. F. M. Kittle browse through the brochures presented to them as a memento from the Bureau. Standing (left to right): W. A. Dexheimer, Commissioner of Reclamation, and F. M. Clinton, Regional Director, Region 6, also enjoy viewing the many pioneer and modern scenes in the book.

Shoshone's Golden Jubilee

SHOSHONE'S GOLDEN JUBILEE marked the 10th Annual Water Users Conference for Region 6 which was held in Powell, Wyo., on September 5 and 6.

The conference was attended by 130 water users from the States of Wyoming, Montana, North Dakota, and South Dakota. It was highlighted by the fact that the Garland division of the Shoshone project in Wyoming was celebrating 50 years of water service. The theme of the conference was tied into the 50-year celebration. Adjacent to the conference hall, one-half of a city block was devoted to a display of old and new equipment. This display was arranged to have the old and the new equipment placed side by side so that people could recall vividly the progress that has been made in development of farm machinery, operation and maintenance equipment, cars and trucks over the years. The display brought hundreds of visitors, and many memories of the "old days" were brought back to the oldtimers. Here, once, again, was an opportunity to relive the days that are now history.

Inside the conference hall, seven large display boards gave a pictorial history from the beginning of construction of the project in 1904 to the present time. The pictures depicted the growth of the town of Powell, Buffalo Bill Dam, and the project. The pictures made one feel proud of the wondrous works that had been accomplished in the last 50 years. It brought back a new appreciation and wonderment of the great desire and determination of the pioneers to cut out homes and farms in this raw sagebush land. It made one think and realize how much the present day generation takes for granted, and how little thought is given to what went on before its time. There was also a display of the old and new in farm home conveniences from the hand-turned washing machines, irons, kerosene lamps, foot warmers, to the latest in stoves, refrigerators, etc.

A banquet was held at the Powell Country Club on the evening of September 5, honoring the original homesteaders who had been on the project 50 or more years. To qualify as an honor guest, one had to still hold ownership to his original farm unit that was homesteaded at least 50 years ago. There were eight honored guests: Mrs. Lulu Shoemaker, Mrs. Margaret Robinson, Mr. and Mrs. Azro Hardy, Mr. and Mrs. Francis Kettle, Albert Lucier, and Mrs. Ida Schacht. To each guest was presented a booklet with a certificate from the Regional Director honoring their 50 years of effort on the project. The booklet contained a short story of the history of the project and a pictorial history of the project from the beginning of construction. These mementos will

by R. M. FAGERBERG,
Bureau of Reclamation,
Powell, Wyo.

be cherished by the honored guests and serve to bring back many wonderful memories for years to come.

The banquet hall was filled to overflowing by the out-of-town guests, local water users, businessmen, and friends of the honored guests. Reclamation Commissioner W. A. Dexheimer was the guest speaker at the banquet, and he spoke on the 50 years of progress on the Shoshone project and the need for a sound water policy for America.

The Water Users Conference held in Billings, Mont., in January 1957 had elected to hold a conference in the field on one of the projects in an effort to study firsthand problems that faced various projects. In previous years the conference had always been held in Billings, Mont., during January, because this was the month when most of the water users felt they could leave the chores at home.

The Shoshone project water users extended the invitation to visit their project and the conference accepted. There was a great deal of apprehension on the part of the planning committee because the conference had to be programed between bean cutting and bean harvesting time. In June the dates were set and in July preliminary programs were sent to over 200 irrigation districts in the 4-State area. All irrigation districts were invited regardless of whether they repre-

H. L. Hart and Reclamation Commissioner W. A. Dexheimer inspecting a pioneer model of an International truck during the 10th Annual Water Users' Conference in Powell, Wyo.

Display Panel, used at 10th Annual Water Users' Conference, featuring oldtime photos of people and scenes on Shoshone project.

sented Federal or private irrigation projects constructed by private companies. This again was a new effort on the part of the conference to have all people interested in irrigation problems get together and talk over their problems.

Followup programs were sent out in August for reservations. A very fine response was received, and it soon became apparent that if everyone came, there would be a shortage of hotel and motel accommodations in Powell. Unfortunately, rainy weather set in over the 4-State area in the latter part of August and delayed harvest of the cereal grains, cutting of beans, and other farmwork. As a result, many of the reservations were canceled. However, even with the cancellations, 130 were in attendance at the conference. The wives were invited to the conference, and a special program of interest was provided for the ladies. They visited the outstanding school system in Powell, the new farm homes on the project, and the new Northwest Community College in Powell.

The first day was spent in the conference hall discussing subjects such as operation and maintenance equipment, control of water weeds, closed and open drains, canal lining and seepage control, saline soils and their reclamation, and rehabilitation and betterment loans. Each discussion was led by a man who had given much time and study to that particular subject and was qualified to enlighten the group on any questions that might arise.

Speakers included R. J. Willson and R. R. Reed, from the Bureau's Denver office; Dr. Howard Haise, from Colorado State University; and

At left: A true western style chuckwagon breakfast, served through the courtesy of the Powell Chamber of Commerce. Commissioner Dexheimer is shown receiving his helping as other members of the conference eagerly await their turn. At right: This panel shows progress of city of Powell from a small settlement in 1911 to a modern city In 1957
All photos in this article by Charles A. Knell, Region 6.

Jesse Hodgson, from Montana State College.

Without a doubt the highlight of the entire conference was a breakfast sponsored by the Powell Chamber of Commerce on the top of Polecat Bench overlooking the entire project. The breakfast was set for 7: 15 a. m., and it required 35 minutes of driving time from Powell over highways and sagebrush land. In the beginning there was a little grumbling over the fact the conferees had to get up so early in the morning and wait so long for breakfast. However, when the group arrived and saw the panoramic view of the project and were served a fine breakfast, consisting of orange or tomato juice, hot sweet rolls, hot buttered toast, fried potatoes, bacon, eggs, coffee, and a cigar, all complaints vanished. There were approximately 110 attending the breakfast.

Demonstration of a Briscoe sloper, shown sloping the banks and clearing weeds on a lateral on Garland division.

The tour began after breakfast with a stop at a canal-lining demonstration. Demonstration plots were set up for bentonite, asphalt, vinyl plastic membrane lining, and a check plot without a membrane lining. The comparative water losses computed on a loss in cubic feet per square foot per 24 hours on the wetted perimeter were given for each of the test plots. During the stop a representative of one of the companies manufacturing the catalytic asphalt for membrane lining discussed the properties of the asphalt. A demonstration of applying the asphalt at 450° Fahrenheit was shown on 2 test plots. A demonstration of concrete "guniting" was shown to the group on rubble riprap.

The tour continued, and a stop was included on the problems arising from drainage of slopes up to 11 percent. The tour continued to the Buffalo Bill Dam, and lunch was furnished by the Willwood Women's Club at the Willwood Community Center.

The afternoon portion of the tour consisted of a Briscoe sloper cleaning demonstration on laterals clogged with silt and weed growths and a propane weed-burning demonstration on control of weeds on lateral banks.

The demonstrations were enthusiastically received by the tour members, and the general consensus of opinion was that a great deal of benefit had been derived from this conference where actual field demonstrations supplemented conference discussion. # # #

ASSISTANT COMMISSIONER "STAN" CROSTHWAIT RETIRES

As this issue went to press, Interior Secretary Fred A. Seaton announced that Stanley W. Crosthwait, Assistant Commissioner of the Bureau of Reclamation since 1953, would retire effective January 31, 1958.

Mr. Crosthwait, Assistant Commissioner for Administration, has had more than 40 years of experience in handling administrative and personnel problems in the Federal Government. He was appointed to his present position on November 30, 1953.

Mr. Crosthwait was born in Greenfield Center, N. Y., December 24, 1898, and received the B. S. degree in electrical engineering from George Washington University in 1928.

He began his public career in the Bureau of Ordnance, Navy Department, in May 1916, and in September 1925 transferred to the Bureau of Internal Revenue in the Treasury Department.

In October 1925, Mr. Crosthwait accepted a position in the Appointment Division of the Department of Commerce, and later served as Chief of the Administrative Division, Aeronautical Branch, until July 1934.

After a tour of duty as Administrative Assistant with the National Power Policy Committee, he joined the Department of the Interior in October 1934. He also served with the Public Works Administration. He was Director of Personnel for the Bureau of Indian Affairs from February 1936 to June 1941, leaving that post to become Executive Officer in the Office of Petroleum Coordinator for War.

He left that position for military duty, serving with the U. S. Air Force from August 1942 to January 1946, as a colonel, a rank he still holds in the Air Force Reserve.

Mr. Crosthwait became Associate Director of Supply for the Bureau of Reclamation at Denver, Colo., in February 1946, and was promoted to Director of Supply in November, transferring to Washington in the same position in January 1947.

He is married and lives at 4205 Sheridan Street, Hyattsville, Md. # # #

Glen Canyon Dam

This suspension footbridge provides ready access to both sides of the Colorado River. It also provides an excellent view of the river—700 feet down—through steel mesh which serves as a deck.—*Photo by A. E. Turner, Jr., Region 4.*

In mid-October of 1956 the President of the United States, via a telegraphic signal from the White House, fired the first blast of rock at the Glen Canyon Dam site. With this signal President Eisenhower marked the beginning of construction on a project which includes the largest single construction contract ever administered by the Bureau of Reclamation.

When completed, the Glen Canyon unit of the upper Colorado River storage project will cost nearly $326 million, and will serve as the key structure in the upper Colorado development.

Prime contract for the construction of the dam and powerplant went to the Merritt-Chapman & Scott Corp., of New York City, on a low bid of $107,955,122. Since the beginning of construction,

Bureau of Reclamation inspectors use a "Sunflower" device to check the arch of the right water diversion tunnel for the Glen Canyon Dam.—*Photo by A. E. Turner, Jr., Region 4.*

FLASH FLOODS through an unimproved section of the Kanab-Glen Canyon highway are a constant headache to construction workers.

LUNCH TIME at the Page Accommodation School. Students park on the front doorsteps as teacher Henry Howe relaxes for a few minutes. School now teaches all grades through high school and boasts 200 pupils.—*Photo by Fred S. Finch, Region 4.*

Temporary headquarters of the Bureau
from the Glen Canyon Dam site. A
of 1,300, Kanab has grown in a ye
people.—*Photo by F. B. Slote, Region*

High-scaling brothers, W. D. Jackson, front, and J. R. Jackson, of Mesa, Ariz., drill out the skewbacks for the Colorado River bridge at Glen Canyon. They work some 200 feet down the canyon wall suspended by cables.—*Photo by F. S. Finch, Region 4.*

the contractors have radically changed the face of the Glen Canyon Dam construction site.

In late October 1957 a 2,760-foot water-diversion tunnel was completed and construction immediately started on a second diversion tunnel on the opposite canyon wall. Drilling companies have started work at both portals of an access tunnel from the canyon rim to the river level for the powerhouse. This tunnel will be almost 2 miles long when finished.

The prime contractor has started excavation on both spillways, and will later drill spillway tunnels to be tied into the lower portions of the diversion tunnels. Merritt-Chapman & Scott Corp. has now moved all administrative offices from Kanab to the dam site.

Bridge abutments for the Colorado River bridge have been built by the Kiewit-Judson Pacific Murphy Co. Skewbacks have been drilled out in the east canyon wall and work is progressing on the arch footings on the opposite side. The contractor anticipates the heavy steel erection on the bridge will start this month.

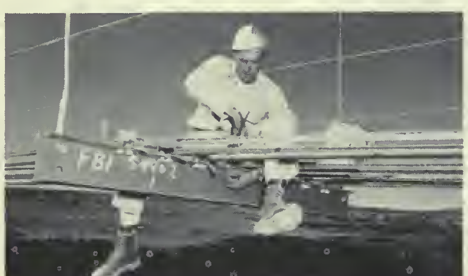
Page, Ariz., named in honor of the late Reclamation Commissioner John C. Page, the Government city to be built by the Bureau of Reclamation, will be well underway by the middle of this

n is located at Kanab, Utah, 76 miles
l tourist city with a normal population
f to a population of more than 3,000

year. To relieve the housing shortage temporary Transahomes were erected, and a school is in operation offering education in all primary and secondary grades. Reclamation officials plan to move all employees and offices to the new city in the near future.

Glen Canyon Dam will be the second highest dam in the United States, being surpassed in height only by Hoover Dam near Boulder City, Nev. The reservoir will impound over 28 million acre-feet of water and will reach 186 miles up the Colorado River and 71 miles up the San Juan River in New Mexico. # # #

Steel rigger Bill Wilds bolts floor cable locks in place on the footbridge spanning Glen Canyon of the Colorado River—*Photo by A. E. Turner, Jr., Region 4.*



Trailer park on the outskirts of the city of Kanab on U. S. Highway 89—*Photo by F. B. Slote, Region 4.*

Modern commissary store, Page, Ariz.—*Photo by A. E. Turner, Region 4.*

Most spectacular part of all road construction for the Glen Canyon Dam is this 300-foot cut through the Echo Cliffs near Bitter Springs, Ariz.—*Photo by Fred S. Finch, Region 4.*

Frontier With A Future

Parker-Davis System Dispatchers' Office—View of the "system diagram board," which pictures the major segments of the entire system with Hoover powerplant at the upper right and the Yuma-El Centro area at the lower left of the diagram.

PART ONE

Supplying system loads at minimum cost consistent with good service is one of the major aims of the modern day power system dispatching organization. The art has become more scientific, and the requirement much more exacting in recent years.

The need of many of the electric-power distributors in the areas served by the Parker-Davis project for supplying low-cost power to a rapidly growing power market for such loads as irrigation pumping, industrial, commercial, and domestic, was one of the compelling reasons which necessitated the establishment of a central power system dispatching center in Phoenix, Ariz.

The pleasant climate in southern Nevada, southern California, and Arizona has always been one of the chief attractions of the area. This resulted in development of the area for growing much of the Nation's food, particularly winter crops, dates, and citrus. The ideal climate, together with the scenic beauty of the area, has also been a major tourist attraction.

After a dynamic period of progress dating back to 1945, the Pacific Southwest area has emerged among the national leaders in growth of population, personal income, manufacturing employment, farm income, retail sales per capita, motor-vehicle registrations, and bank capital and deposit growth. Any day of the year, any place you want to go in this large Pacific Southwest section of the Nation, you can hear, see, and feel the growth. No wonder it's called the "Frontier with a Future"!

Electric-power development, wherein service is provided at minimum cost, has played a major role in this areawide recordbreaking activity.

Possibly the largest contributing factor in the development of a power system, and the dispatch-

by WILLIAM M. DOAK, Chief, Systems Operation Division, Parker-Davis Project Office, Phoenix, Ariz.

ing organization necessary to operate it, is the geography of the territory served. The location and distance between the major load centers and other interconnected utilities on the system, the location of suitable sites for establishing hydroelectric generating stations along with the necessary transmission and communication facilities that result from such locations, all influenced the development of the methods and the overall arrangement of the Parker-Davis system as a whole.

The Colorado Basin extends from Wyoming on the north into Mexico on the south, and from the western slope of the Rocky Mountains to the Gulf of California—an area of 242,000 square miles in the United States and 3,000 square miles in Mexico. The Parker-Davis power system serves the territory extending from Clark County, Nev., on the northwest; to Imperial County, Calif., on the southwest; to Cochise County, Ariz., on the southeast; or a territory extending about 300 miles east and west by approximately 500 miles north and south. There are several major, as well as colorful, cities in this area, including Las Vegas and Henderson, Nev.; El Centro, Brawley, and Calexico in Imperial Valley, Calif.; Prescott, Yuma, Phoenix, and Tucson, Ariz.; and San Luis, Old Mexico; and many others too numerous to mention, each with its concentration of load. The distance between the major load centers varies from approximately 60 to 100 miles.

The Parker-Davis power system presently consists of 2 dams, 2 hydroelectric powerplants, nearly 1,600 miles of high-voltage transmission lines, and 36 substations. Power is transmitted at 230 kv., 161 kv., 115 kv., 69 kv., and 34.5 kv. There are 19 interconnections with other utilities, many of which have generating facilities of their own. The substations on this system have a combined transformer capacity approaching 2 million kv.-a., including the transformer capacity at the powerplants.

The hydroelectric powerplants are located at Parker Dam and Davis Dam, with interconnections between these plants and Hoover powerplant.

Parker powerplant has 4 hydroelectric generating units, each with a nameplate rating of 30,000 kw., or a plant capacity of 120,000 kw.

Davis powerplant has 5 hydroelectric generating units, each with a nameplate rating of 45,000 kw., or a plant capacity of 225,000 kw.

In addition to the 345,000 kw. combined capacity of these 2 plants, the system also transmits

Here are shown the 53 telemeters presently installed. The radio transmitter is in the foreground. The office is open 24 hours a day, with 2 system dispatchers on duty each 8-hour shift.

DATE PALMS—Typical of the diversity of crops in the area is this date palm in a grove near Mesa, Ariz. Mesa, a land of figs, dates, citrus, melons, truck crops, cotton, and grains, has a population of 18,000 and a trading area population of 65,000.

165,000 kw. and 155,000 kw. of Hoover powerplant capacity for the Arizona Power Authority and the Colorado River Commission of Nevada, respectively. The 1,600 kw. of Siphon Drop powerplant, located on the Yuma Main Canal near Yuma, Ariz., is also connected to the system, making a total of 667,700 kw. of hydroelectric generation under the dispatching control of the system dispatchers located in Phoenix, Ariz. The project also transmits 200,000 kw. of steam power from the Arizona Public Service Co.'s new Saguaro steam electric generating station connected to the project's 115-kv. transmission system. Southern Nevada Power Co.'s new 100,000-kw. Clark steam electric generating station located near Las Vegas, Nev., is directly connected to the project's 230-kv. system at Basic substation. The Parker-Davis system dispatchers are directly concerned with a total generation of 967,000 kw. In addition, the power systems directly interconnected with the Parker-Davis system have a combined capacity in excess of 1,000,000 kv.-a. In the event of disaster resulting in a permanent loss of all or part of the system generation, it would be possible to reroute a portion of this interconnected generation over the Parker-Davis system.

CENTRAL SYSTEM DISPATCHING OFFICE

The general offices of the Parker-Davis project are located approximately 5 miles west of downtown Phoenix, and directly across the street from the Arizona Public Service Co.'s "Phoenix" steam electric generating station. The steel-reinforced concrete central dispatch building, adjacent to the project's general office building, houses the Chief of the Power Dispatching Branch, the Assistant Branch Chief, and 10 system dispatchers.

All intelligence essential to system load dispatching system scheduling, and systemwide operations is continuously available to the dispatchers who are responsible for the safe, efficient, and dependable operation of the power system.

The key feature of this central dispatching office is the large curved telemetering instrument and system diagram board. This board is approximately 80 feet long and 12 feet high. The 53 telemeters presently installed and the system dispatching diagram can be seen in the accompanying photographs. The functions of the telemeters will be explained in the second part of this article.

SYSTEM DISPATCHERS' OBJECTIVES

The objectives of the system dispatchers are: (1) To see that the operations on this power system are conducted in such a manner as to provide for the maximum and efficient use of water available for power generation, consistent with flood

Yuma citrus crops have little fear of severe frosts. It can grow a wide variety of crops in the summer or winter. Lettuce is harvested early, and brings top prices in eastern markets.—*Photo by Harry W. Meyers.*

control, irrigation, and other releases; (2) to provide uninterrupted service to project customers; (3) to provide adequate system stability and voltage levels; (4) to allow for the construction and installation of new or replacement facilities; and (5) for the complete coordination of the project's systemwide operations and maintenance programs with those of the interconnected utilities.

All of these responsibilities constitute a very important function essential to the successful operation of this portion of the interconnected power systems of the Pacific Southwest. Government owned and leased telephone circuits, carrier-current voice channels, microwave, and the project's network of base-mobile and point-to-point radio channels are used for communication in accomplishing these objectives. Nowhere in the Nation does electric power mean more to present life and future development than in this vast area.

Part 2, the concluding part of this article, will appear in the next issue of the Era. # # #

CROP SURPLUSES NEARING AN END

RECLAMATION COMMISSIONER DEXHEIMER presented another well-reasoned case for multipurpose water development projects, with special emphasis on the role Federal power revenues play in footing the bills.

As a speaker in the lecture series on conservation at the 84th annual convention of the Chautauqua Institution at Chautauqua, N. Y., Mr. Dexheimer first spiked what he called a "misapprehension" about reclamation and farm surpluses. "We are constantly asked," he said, "why the Federal Government should invest money in irrigating farmlands when it is paying out billions for surplus crops."

Westerners already know the answer. Five basic crops make up 87 percent of the Nation's agricultural surpluses. Of these, reclamation produces no tobacco; only half of 1 percent of corn and rice, less than 2 percent of wheat, and less than 5 percent of upland cotton.

Surpluses or no, Mr. Dexheimer declared "we are rapidly running out of farmland." Every year another million acres goes out of crop production, and another 3 million mouths have to be fed. In 5 years or less, he predicted, farm surpluses will cease to be a problem, and the Nation will face instead "an approaching crisis in our agricultural production." #

FISH PROTECTION

Continued from page 7

DELTA-MENDOTA CANAL—Typical catch for the fish count showing the number of fish caught in a 5-minute period.

While the following figures do not reveal what proportion of the fish is being caught, they do show that the numbers are substantial and seem to amply vindicate the selection of the louver principle in fish collection, at least in the Tracy situation. The program of measuring catch to escapement initiated in 1957 will continue through 1958.

1957	Striped bass	Salmon	Catfish	Other	Total
February					[1] 97, 000
March	33, 512	3, 288	52, 461	33, 610	122, 871
April	33, 920	116, 684	85, 396	20, 348	256, 348
May	20, 952	85, 407	73, 168	51, 071	230, 598
June	237, 830	11, 600	102, 036	72, 588	424, 054
July	1, 101, 218	512	785, 093	47, 972	1, 934, 795
August	330, 112	312	88, 918	36, 192	455, 534
September	12, 192	192	5, 664	2, 424	[2] 20, 472
Total					3, 541, 672

[1] Estimated.
[2] Fishing terminated for season on Sept. 11 due to low volume of pumping and smali catch.

Editors note:

The Department of the Interior granted cash awards totaling $12,000 to the 3 employees who were considered to have contributed the most to the development of the above described fish protection facilities. This was the largest such grant in Interior's history.

# # #

RECLAMATION AND HURRICANE AUDREY

Continued from Page 4

52 miles away with only 2 connecting roads; thus there was little opportunity to conveniently and efficiently fall back on a willing neighbor.

Nevertheless, in less than a week after Audrey hit, over 400 paid laborers, from as far as 150 miles from Cameron, began commuting daily in the cleanup operations. The Louisiana State Highway Department furnished a top construction engineer and about 20 pieces of equipment. Close to 40 additional construction vehicles were rented from a contractor. There were additionally about 15 pieces of equipment that were donated. These often arrived within a day of the storm, and did a yeoman job of the first debris removal from main streets. Much of this equipment remained for 2 or 3 weeks' work. The armed services also contributed generously, particularly during the early chaotic period.

Although the bulk of the cleanup had to be done in Cameron, there were 50 additional miles of small communities and homes near the gulf and 1 or 2 towns well inland requiring extensive removal of debris. This extensive area, coupled with a large commuting construction organization put together in a matter of hours, could hardly be expected to be very efficient. However, within 2 weeks the unwieldy, hastily-put-together construction organization developed into a reasonably well-oiled, efficient producing crew.

The total estimate for debris clearance exceeded one-half of a million dollars. It was necessary that this estimate be prepared well in advance of completion of the work in order that Federal funds could be made available early. The importance of securing funds cannot be overestimated, since the Cameron Parish (county) treasury could only pay 3 days' wages of the hired labor, and the wiped-out condition of practically everyone precluded the expectation of normal revenue for many months.

Although debris clearance was my principal work assignment, it was by no means all. The problems were legion; the conferences to work them out were innumerable; the hours worked were generally the "awake" hours of a day; Saturdays, Sundays, and holidays were alike. All problems revolved around the basic fact that practically all people and the parish government were without funds. The average person

A FREAK OF THE STORM—This fully gabled roof settled relatively undamaged on the ground after losing its ground floor.

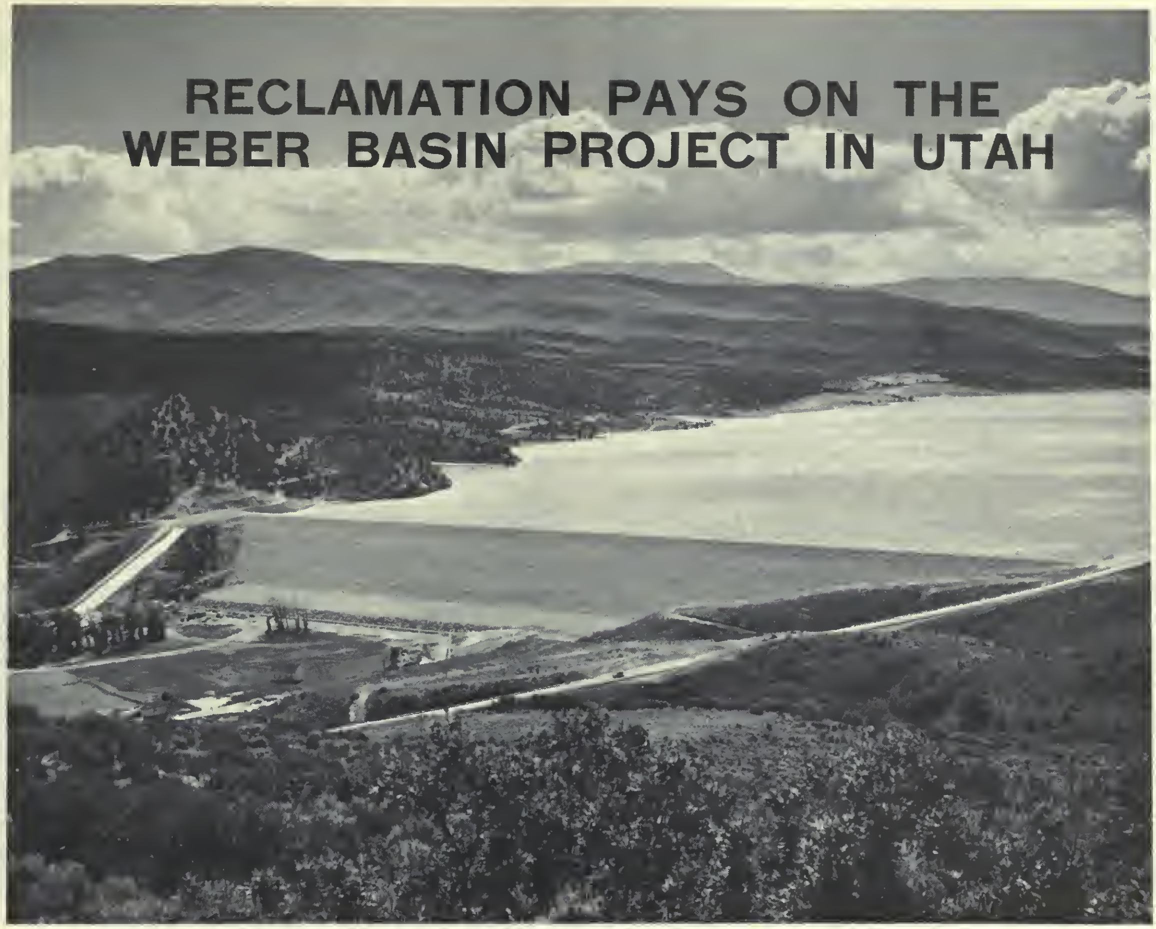
was not only broke, but he had not collateral with which to borrow. He was without means to obtain the essentials necessary to bring a semblance of order to his home; such as shovels, gloves, crowbars, saws, hammers, lawn hoses, water pumps, water pipe for essential repairs, etc. If he had some money, he would have to travel 50 miles for the simplest purchases as no stores or filling stations were open. Even then transportation was a problem, as most automobiles were destroyed, with only partial insurance coverage. Further, their means of making money had been removed as their jobs were gone. Thus, their least need often required considerable planning.

Through all these problems, the patience and appreciation of these people were amazing. These fishermen are indefatigable workers, never complaining. And they thank you, from the bottom of their hearts, for all you do for them. Far too often what is done is too little; sometimes nothing is accomplished. But they still thank you for the effort, and mean it. # # #

Hungry Horse Concrete Gains in Strength

Recent laboratory tests of 10-inch diameter drill cores from Hungry Horse Dam representing interior concrete placed from 5 to 8 years ago, indicate continued strength development of the dam's concrete. The 8-year-old cores indicate a compressive strength of 5,460 pounds per square inch, a gain of 420 p. s. i. since 1952 when similar tests were made.

RECLAMATION PAYS ON THE WEBER BASIN PROJECT IN UTAH



WANSHIP DAM—Weber Basin Project, Utah.—*Photo by Stan Rasmussen.*

The first phase of Utah's $70,523,000 Weber Basin (reclamation) project is largely completed, and limited water service was begun in July 1957 to meet the urgent needs for municipal and industrial water and for irrigation of farmland. The project was conceived, designed, and constructed by the U. S. Bureau of Reclamation in response to the need for additional water supplies of the people residing in the drainage area of this important stream—the Weber River. The Weber Basin project is a model "multiple purpose" development, theoretically harnessing for beneficial uses all of the remaining water resources of the Weber River.

Developments for use of Weber River water prior to the Weber Basin project were undertaken by organized groups, by individuals, and by the Federal Government. Many private companies and individuals have contributed greatly to the development of an extensive network of canals that carry water to more than 100,000 irrigated acres. These same groups have also built many small reservoirs with an aggregate capacity of about 40,000 acre-feet. The final development was the Weber Basin project, which involves the "last roundup" of water in the Weber River drainage area.

The Weber Basin project development is designed to utilize the waters of the Weber River and its tributaries not yet put to beneficial use. Project construction includes reservoirs and other conveyance facilities, drainage works, and groundwater development. Specifically, the beneficial uses of the expanded water supply are primarily for municipal, irrigation, and industrial purposes, and secondarily for pumping power, development of fish and wildlife facilities, recreation facilities, and flood control.

The major storage features will consist of 5

by HAROLD E. ELLISON
President of Weber Basin Water Conservancy District, Layton, Utah

GATEWAY CANAL, Weber Basin Project, near Peterson, Utah.—*Photo by F. H. Anderson.*

reservoirs with a combined total capacity of 373,000 acre-feet of water. The 2 key reservoirs in the first phase (the project is being built in 2 phases)—Wanship and Pineview—are completed. Other essential features of the first phase for diversion, conveyance, and stored water are the Stoddard diversion works, the Gateway canal, the Gateway tunnel, the Davis and Weber adqueducts, and the Slaterville diversion works.

These first-phase storage-diversion and transportation facilities produce 76,000 acre-feet of water, 20,000 of which will be used for municipal purposes and 56,000 acre-feet for irrigation purposes. The second phase of the project development will produce an additional 110,000 acre-feet of water, of which another 20,000 acre-feet will be utilized for municipal and industrial purposes and the remaining 90,000 acre-feet for irrigation. This will create a firm water supply of 186,000 acre-feet for the Weber Basin project area.

Irrigation benefits will arise for providing supplemental water to 24,400 acres now only partially irrigated, and a full "new water" supply to 51,210 acres.

The Weber Basin project stood the test of economic feasibility solely because of its multiple-purpose features. The area was rapidly moving into a municipal and industrial water famine. In addition, many splendid acres of irrigable land were remaining unproductive because of lack of irrigation water. Industrial development in the area was grinding to a slow halt because of limited water supply. Practically all of the communities in Davis and Weber Counties were so short of water that restricted delivery was imposed annually during the high use periods.

When the Weber Basin project was authorized on August 29, 1949, by the Congress of the United States, the statute carried a provision that a contract guaranteeing repayment of construction costs must be executed between the Bureau of Reclamation and an entity that had taxing powers. The Water Conservancy Act of Utah provided an answer to this requirement, and the Weber Basin Water Conservancy District was legally created on June 26, 1950. In due course a contract was signed on December 12, 1952, under which the district would repay the United States the reimbursable costs of the project. These reimbursable costs total more than $57 million and include the costs for constructing the major facilities for storage and transportation of water, plus other programs such as drainage.

There still remained the need for facilities for treating water to be used for municipal and industrial purposes. The responsibility for providing treatment plants and delivery systems was accepted by the conservancy district. The district financed construction of these water-treatment and delivery systems through the sale of a bond issue which, when fully completed, will amount to about $10 million. Thus, the total costs involved in the Weber Basin project, including the nonreimbursable items, will exceed the $70 million mark.

The contract and bond issues created a firm partnership between the district and the United States, providing first for the repayment by the district of the reimbursable amounts for construction of project facilities, and for the operation of the project after its total completion; and second, for the responsibility of financing, constructing, and operating the treatment plants which were to receive the raw water from the reclamation project and convert it to usable domestic water.

The district proceeded with its particular responsibilities and now has built and put into operation three sizable filtration plants and the necessary pipeline systems, and domestic water of excellent quality is now being delivered to the communities in Davis and Weber Counties along the Wasatch Mountain front.

The combined capacity of the treatment plants is 40 second-feet of water, or about 26 million gallons daily. The plant designated as No. 2, located southeast of Ogden City, receives its raw water from the Weber aqueduct, which is the north leg

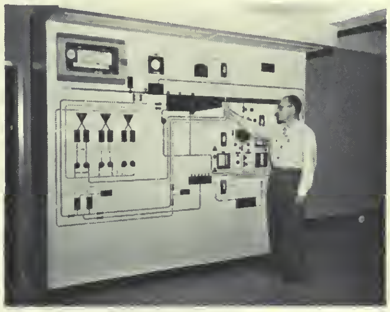
of the aqueduct system starting at the west portal of the Gateway tunnel; plant No. 3, located at the intersection of Hill Field Road and U. S. Highway 89 in Davis County, and plant 4, located east of Bountiful City, obtain their raw water from the south leg of the aqueduct system, known as the Davis aqueduct. These three plants adequately provide for and produce the needed domestic water for the municipalities. (The original plan of the district was to build four plants. Plant No. 1 on the Ogden River was designed by the conservancy district, but, upon request, was actually built and is now owned and operated by the city of Ogden.)

Construction on the first phase of the Weber Basin project has been continuous. Adequate Federal appropriations have permitted uninterrupted work. First construction started with the boring of 3.3 miles of tunnel through the mountain which parallels the Weber River, starting at Gateway on the east and emerging at the mouth of Weber Canyon on the west. The first construction was marked by a ceremony and blasting operation on January 9, 1953, at the west portal of the tunnel, at which Federal Government, district, and State officials were present, as well as representatives of water groups.

Construction progress continued at a rapid pace, and on May 9, 1957, the second event of great significance to the Weber Basin project occurred with the dedication of the recently completed Wanship Dam and Reservoir in Summit County and the first storage of Weber Basin project water began. Wanship Dam is the key upstream retention facility around which the delivery of first-phase water revolves. More than a thousand persons attended the dedicatorial ceremony at the dam site, at which time Utah's senior Senator, the Honorable Arthur V. Watkins, presented the dedicatorial address, and the gates controlling the outlet works of the dam were officially closed by the U. S. Commissioner of Reclamation, the Honorable W. A. Dexheimer.

During the 1957 runoff season, a total of 59,000 acre-feet of water was stored in Wanship Reservoir, only 1,000 acre-feet less than its capacity. It is interesting to note that this reservoir has an unusual distinction in being allowed to fill to capacity the first year of its use.

The third and most encouraging date in the first phase development was in July 1957 when the stored waters from the Wanship Reservoir were released and turned into project and district facilities for beneficial use by irrigators, industries, and municipalities.



At left: Water purification plant No. 2, of the Weber Basin Conservancy District. Center: Control panel of the plant. Mr. Harold Dean, Weber Basin Project Office, explains its operation. At right: End of Gateway Canal. Tunnel entrance at left Future powerplant in the center. Spillway and upper end of wasteway at right.—*Photos by F. H. Anderson, Region 4.*

The Weber Basin project is very complicated in its general design and plan of operation. The total storage capacity will exceed normal annual requirements by 2½ times. Thus, provision is made not only for water delivery in years of low precipitation and runoff, but also for water exchanges that will assure ample water delivery and full crop production in years of short supply. Provision for such heavy carryover does materially increase the cost of the project, yet it is most essential if the needs of the people are to be fully satisfied on a long-range basis. It is estimated that, with the production of the watersheds and with the carryover provisions of the project, there will never be an inadequate municipal water supply, and rarely will there be a shortage, even, of irrigation water.

The Weber River has always produced what is considered sufficient water for the total economy of the drainage area, but much of it is produced below any points where it would be

possible to retain it or use before it flows into the Great Salt Lake. Thus the Weber Basin project was designed to capture that water after it has done full duty, and store it for exchanges for beneficial consumptive and nonconsumptive uses. The water now diverted out of the Weber River to irrigate lands in the lake-plains areas will be turned out of the river at the Stoddard diversion dam and used on the foothills sections in Davis and Weber Counties, served by the Davis and Weber aqueducts, and the added storage in the enlarged Pineview Reservoir. The complications involved in administration are many; yet they have a common, practical solution, made possible because of Utah's water distribution practices in accordance with rights established under supervision of the State engineer's office and the statutes which fully provide for the exchanges.

It must be recognized that the principal purpose of the Weber Basin project is to increase the beneficial use of the area's natural resources—the land and the water—which, in turn, will directly affect the municipalities, the industries, and the rural areas within the project. The final test of the economic value to the area of the Weber Basin project can be determined only after history records the equation of economic benefits in the next several years. Careful estimates of the economic repercussions of the project were carefully programed and compiled by the Bureau of Reclamation.

The indications are that complete development of the Weber Basin project will result in the following contributions to the general economy of the project *each year:* $9 million in crops and

STODDARD DIVERSION DAM.—*Photo by Stan Rasmussen.*

livestock; $1,500,000 in State and county taxes; $256,000 in fish, wildlife, and recreation benefits; $500,000 in interest in increased financing; $4 million in increased day labor earnings. Taking into consideration a decrease annually of $202,000 in flood damages, the increased contributions to the general economy derived from the Weber Basin project will amount to more than $16 million each year.

In addition, over the 60-year repayment period, land values will be increased $1 million; investments in buildings, machinery, and equipment will total $12,600,000; and purchases of farm supplies will be increased by $5,300,000.

The Weber Basin project once again demonstrates that "reclamation pays"—in Utah and elsewhere in the West. # # #

Oranges and Grapefruit, Larger Crops

The statistical summary of the United States Department of Agriculture reports that the Nation's 1957–58 Early and Midseason orange crop, forecast at 73.3 million boxes, will top the 1956–57 crop by 3 percent. Larger crops in all citrus States except California where a 22 percent smaller production of navels and miscellaneous oranges is in prospect. Florida's 59 million boxes of Early and Midseason oranges (including 3 million Temples) will top last year by nearly 9 percent; production in Texas, Arizona, and Louisiana is expected to top last season by 25 percent.

U. S. grapefruit crops 1957–58 harvest) is expected to total 45.3 million boxes, 5 percent above last year. #

YOUR MAGAZINE

Are there particular types of articles which you would like to see in the Era that we have not printed to date? If so, please let us know, and we shall do our best to comply with your wishes.

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If you have friends or associates who would be interested in the Reclamation Era, please send their names and addresses to the Bureau of Reclamation, Washington 25, D. C. We shall be glad to send them copies of back issues.

The Whirlybird Patrol

The Parker-Davis project operates and maintains 2 powerplants, 36 substations, and approximately 1,500 miles of high-voltage transmission lines in southern Nevada, southeastern California, and Arizona.

Electric power from this system serves city and rural dwellers, and it is the aim of the project personnel to maintain uninterrupted electric service to all. This is important to the farmer and cattleman who depend upon a reliable supply of electric power to accomplish the many and varied tasks being performed on the modern-day farm and ranch. Without electric power, water for irrigation and stock would cease to flow. Excessive or prolonged delays in the restoration of service could result in crop damage and other severe losses to the rural people located in these areas.

Arizona is a lot of things to a lot of people, and there is a lot of Arizona—113,956 square miles of it—and every one of those square miles has something to offer and each square mile is different from the next. This is also true of the Nevada and southern California areas served by the project. A lot of very interesting and very diversified scenery and terrain is crowded within these areas in the three States in which the project operates.

Arizona, for example, spreads out in all directions, and it goes up and down in just as merry a manner, resulting in innumerable headaches and problems to the engineers responsible for electric-power-system operations and maintenance.

In elevation, Arizona varies from 137 feet above sea level near the Mexican border southwest of Yuma to Humphrey's Peak in the San Francisco Range near Flagstaff, which pokes its head 12,655 feet into the air. Within these low and high points are three general geographical regions, typical desert in the southwestern part, a forested mountain region in the central and eastern parts, and the high wind swept plateau region to the

by WILLIAM M. DOAK,
Chief, System Operations Division,
Parker Davis Project Office,
Phoenix, Ariz.

northwest. Variety, indeed, puts spice in our transmission line maintenance.

Whims of elevation in Arizona also account for the whims of our weather, and as a result, still more pressing problems are heaped upon the shoulders of the power line maintenance crews.

In resolving some of the terrific problems associated with the operations of the power system, the Parker-Davis project took a close look at the helicopter.

We consider the helicopter's exclusive ability to rise and descend vertically and to hover motionless at any height makes it literally a flying "jack of all trades." Mountains, rivers, marshlands, woods, water, or lack of roads present no obstacles. Isolated spots that cannot be reached by any land vehicle become easily and quickly accessible by helicopter. A helicopter flies direct, requiring landing sites hardly larger than its own size. When there is not sufficient area on which to land, ground contact can be made by the helicopter's hoist, which lowers personnel and equipment to the desired location, with actual landing being made nearby.

Prior to purchasing the helicopter, the project made a 3-month trial use of a helicopter by contract with a private company. Convinced by this trial that such an operation was feasible and very economical as compared with other methods of operation, a helicopter was purchased early in 1951.

The results during the past six years have exceeded our expectations. Substantial savings in cost of line patrol have accrued over the conventional method of patrol by linemen in jeeps and

TRIAL USE of the helicopter pictured here near Coolidge, Ariz.

Parker Davis project's helicopter landing at the Arizona Public Service Co.'s Saguaro steam plant near Redrock, Ariz.—*Photo by Arizona Public Service Co.*

pickups. During the past six years our costs for line patrol, including salaries, operation, maintenance, and depreciation have averaged about $18,000 per year. For the past 3 years, the costs are running less than $15,000 per year. This helicopter patrol is considerably cheaper than ground patrol of the same frequency and quality.

Furthermore, the quality of helicopter patrol is superior to ground patrol. The observer is in a comfortable position, slightly above and to one side of the line. He is not forced to gaze into a glaring sky, and he is thus able to quickly detect minor troubles in structures, fittings, or conductors before they become serious. Many possible future power outages are thus avoided.

In addition to its use for routine patrol, the helicopter is particularly useful and valuable in emergencies in locating trouble causing line outages. In case of a permanent line fault, the helicopter can get underway and cover a 100-mile stretch of line in less than 2 hours over desert or mountainous terrain that would take ground patrols many hours to cover. Outages are quickly located, the description of the trouble and equipment and materials needed for repairs are radioed back to headquarters and line crews dispatched with minimum loss of time to repair the trouble and restore service. This is of particular interest to farmers and ranchers operating within irrigation districts and REA's served by the project who have no source of standby power. The hazard of crop losses due to lengthy outages is greatly reduced, and the inconvenience of interruptions to homes and business throughout the area we serve is greatly minimized. # # #

WEED CONTROL BY SLIDE RULE

A standard pocket slide rule can be modified to make a handy calculator of weed control spray rig problems in the field as well as in the office. Figure 1 shows how this was done by E. G. Cakin, weed control specialist for the Tracy Operations Field Branch of the Central Valley project in California.

The rule he modified is a K & E No. 4907 B, which is made of white plastic, has the regular C, D, CF, DF, and CI scales on the front face and an inch and metric rule on the edges of the back. The basic modification consisted in inscribing nozzle spacing marks above the DF scale and marking the CF scale for miles per hour, the C scale for gallons per minute, and the D scale for gallons per acre.

To locate the points for inscribing the nozzle spacings, a problem is worked out to give a certain nozzle spacing in inches. Figure 2 is an example of such problem. To obtain a coverage of 150 gallons per acre, with nozzles spaced 18 inches apart and discharging 2.25 gallons per minute per nozzle, the rig must travel at a speed of 4.95 miles per hour.

As in the example shown, set 2.25 on C scale over 1.5 on D scale. Above 4.95 on CF scale inscribe a mark for a nozzle spacing of 18 inches. Remove the slide, reverse its direction, and set 18 on the CF scale in line with the 18-inch mark on the DF scale. Inscribe any desired nozzle spacings on the DF scale from the corresponding points on the positioned CF scale and the rule is completed.

To be more usable in the field, Mr. Cakin has inscribed on the back of his rule a chart giving the discharge in gallons per minute for the most used nozzles, and various formulas and conversion factors.

Along with replacing long hand calculations and charts and nomograms, this rule is still usable as a regular slide rule. # # #

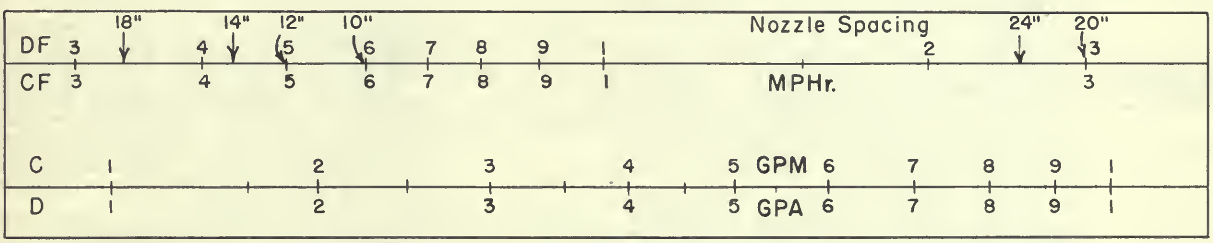

Figure 1 Detail of standard slide rule with special inscription

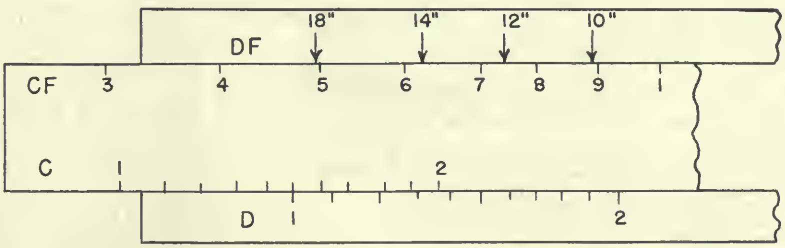

Figure 2 Detail for example

Construction and Materials for Which Bids Will Be Requested Through March 1958

Project	Description of work or material
Boulder Canyon, Nev.	Removing 3,500 square feet of terrazzo and underbed from the Safety Island floor and replacing with 2.25-inch-thick concrete underbed and 1-inch-thick terrazzo. The terrazzo has a complex and elaborate design involving strips, discs, plaques, and lettering in addition to the usual divider strips. Near Boulder City.
Central Valley, Calif.	Constructing twelve 18- and 24-inch-diameter pump turnouts with 4- by 6-foot meter boxes, two 24-inch-diameter gravity turnouts and modifying a turnout structure. Delta-Mendota Canal, between Gustine and Volta.
Do	Structural steel trashracks for Trinity Dam. Estimated weight: 700,000 pounds.
Columbia Basin, Wash.	Placing compacted earth lining in about 3 miles of laterals in Block 40, north of Moses Lake and Blocks 85, 86, and 87, about 18 miles northwest of Othello.
Do	Placing concrete lining in about 6 miles of laterals in Block 77, about 14 miles south of Quincy, and Block 701, west of Soap Lake.
Do	Earthwork and structures for about 8 miles of open-ditch drains. Work will include about 3 miles of drain extensions and deepening about 1.75 mile of drain. Block 72, east of Quincy, Block 87, northwest of Othello, and Block 49, southwest of Othello.
Do	Furnishing and installing 19 gear-motor drive units and automatic controls including stilling wells for conversion of manually-operated radial gates to automatic operation. Potholes East Canal, about 12 miles west of Eltopia, and West Canal, about 20 miles northwest of Othello.
Do	Constructing shop, residences, and service buildings for Wahluke Watermaster Headquarters in Block 20, south of Othello.
Do	Constructing additional protective fencing for pumping plant installations at various locations on the project.
Do	One 32- by 20-foot radial gate including embedded metalwork for the Esquatzel Diversion Canal. Estimated weight: 45,000 pounds.
Colorado River Storage, Utah.	Constructing a water supply system for the Flaming Gorge community. About 16 miles southeast of Linwood.
Colorado River Storage, Ariz.	Constructing a 344- by 144-foot administration building (part permanent and part temporary), a 146- by 70-foot garage and fire station, a 112- by 29-foot dormitory, and a 96- by 48-foot police building. At Page, about 135 miles north of Flagstaff.
Crooked River, Oreg.	Constructing the 186-foot-high earth and rockfill Prineville Dam, containing 1,350,000 cubic yards of material, crest length of 780 feet, and appurtenant structures. On the Crooked River, about 21 miles southeast of Prineville.
Fort Peck and Missouri River Basin, Mont. and N. Dak.	Furnishing and erecting steel towers for about 309 miles of the single circuit, 230-kilovolt, Fort Peck-Dawson County-Bismarck Transmission Lines. Work will include clearing rights-of-way, furnishing and installing fence gates and constructing footings. From Fort Peck through Glendive, Mont., to Bismarck, N. Dak.
Gila, Ariz	Constructing 2 reinforced concrete baffled apron drops and excavating for floodway channels to the Texas Hill Floodway. Near Growler.
Do	Constructing one 40- by 60-foot office building of block-type construction, and furnishing and erecting one 40- by 60-foot prefabricated steel shop building. At Yuma.
Little Wood River, Idaho.	Raising the earthfill Little Wood River Dam 42 feet and constructing a spillway and an addition to the outlet works. On the Little Wood River, about 11 miles northwest of Carey.
Do	Clearing 1,060 acres of cottonwoods and willows and 60 acres of aspens and brush from the Little Wood River Reservoir area, north of Carey.
Middle Rio Grande, New Mex.	Converting three 15-foot 4-inch by 9-foot 3-inch multiplate corrugated metal pipe arch road culverts to check structures by installing slide gates at inlets to pipe arches and extending the lengths of the pipe arches in the conveyance channel. Rio Grande, near Socorro.
Minidoka, Idaho	Earthwork and structures for open ditch laterals from 4 wells. Ten miles northwest of Paul.
MRB, Nebraska-Kansas.	Furnishing and installing 5 fixed radio stations and 25 mobile sets. No houses will be required. At Courtland, Kans., and Franklin, Red Cloud, Superior and Cambridge, Nebr.
MRB, North Dakota.	Two 230-kilovolts and five 14.4-kilovolts potential transformers; two 230-kilovolts, 1,200-ampere, 5,000-millivolt-amperes interrupting capacity power circuit breakers and two 14.4-kilovolts, 2,000-ampere, 1,500-millivolt-amperes interrupting capacity power circuit breakers. For Fargo substation.
MRB, South Dakota.	Constructing the 82- by 74-foot, one-story Watertown power system dispatching building with concrete masonry unit exterior walls and interior partitions having wood studs and dry walls on both sides. Work will include installing a sewerage system. Near Watertown.
Do	Constructing additions to the Summit substation. Work will include grading and fencing an extension to the substation, constructing concrete foundations, furnishing and erecting steel structures, and installing a 110/41.8-kilovolts, 8,000-kilovolt-amperes transformer, two 46-kilovolts circuit breakers and associated electrical equipment. Near Summit.
MRB, Wyoming	Two 144-inch butterfly valves for the Fremont Canyon powerplant. Estimated weight: 270,000 pounds.
Do	One 750-kilovolts station service unit substation with 750-kilovolts standby capacity for the Fremont Canyon powerplant.
Do	Trashracks for intake structure at Fremont Canyon powerplant. Estimated weight: 164,000 pounds.
Parker-Davis, Arizona.	Painting the exteriors of 48 houses and 32 garages at Davis Dam, 32 miles west of Kingman; at Parker Dam, 12 miles northeast of Parker; and at Coolidge, Mesa, and Tucson.
Rogue River Basin, Oreg.	Constructing the 115- to 85-cubic-feet-per-second-capacity Dead Intian Collection Canal, about 3,000 feet long, a rockfill-type diversion dam about 5 feet high and 100 feet long, and headworks structure; constructing the 25-cubic-feet-per-second-capacity Conde Creek Collection Canal, about 2.5 miles long, a rockfill-type diversion dam 5 feet high and 75 feet long, and headworks structure; and constructing improvements to the Grizzly Creek channel, about 1.5 miles long. Work will include constructing road crossings, drops, drain inlets and timber bridges. About 15 miles northeast of Ashland.
Do	Relocating the Hill Cemetery from the Emigrant Reservoir area near Ashland.
Shoshone, Wyo	Constructing 5.1 miles of closed drain and 0.76 mile of open ditch drain. Fourteen miles northeast of Cody.
Ventura River, Calif.	Furnishing and erecting 5 circular steel tank reservoirs or constructing 5 circular prestressed concrete reservoirs ranging from 250,000 to 3,500,000 gallons. Four tanks are to be 40 feet high with diameters of 130, 115, 90, and 70 feet and one tank is to be 24 feet high with a 44-foot diameter. Near Ventura.
Do	Constructing 5 outdoor-type pumping plants including control buildings with concrete masonry unit walls and roofs of metal joists with wood decks and built-up roofing to house the electrical control equipment. Work will include installing electrical control cubicles and the following electrically driven horizontal pumping units at each plant: 4 of 50 cubic feet per second total capacity at Ventura Avenue No. 1; 3 of 48 cubic feet per second total capacity for Ventura Avenue No. 2; 3 of 20.7 cubic feet per second total capacity for Ojai Valley; 2 of 8.2 cubic feet per second total capacity for Upper Ojai and 2 of 6.4 cubic feet per second total capacity for Rincon. North of Ventura.
Do	Furnishing and installing a complete automatic control and telemetering system for a municipal water district. System shall provide automatic control for starting and stopping pumps in 5 pumping plants based on water levels in tank-type reservoirs. Continuous transmission of telemetering signals to a dispatch office in Oak View from 5 reservoirs, 3 chlorination stations, and 5 pumping plants will be required as will continuous transmission or supervision of alarms. Information will be transmitted over leased telephone lines. Work will include constructing 10,000 feet of 2-wire telephone lines. Vicinity of Oak View and Ojai.
Do	One fabricated steel bulkhead gate, track, and screens for the Casitas Dam. Estimated weight: 182,000 pounds.
Wapinitia, Oreg	Constructing the 42-foot-high earthfill Wasco Dam, containing about 45,000 cubic yards of material and having a crest length of 390 feet, appurtenant structures, and about 1 mile of gravel access road. On Clear Creek, about 35 miles west of Maupin.
Washita Basin, Okla.	Constructing a field office, laboratory and pump house, and installing domestic water and sewerage disposal systems, and liquefied petroleum gas system. North of Foss.
Weber Basin, Utah.	Constructing 4 pumping plants consisting of 2 outdoor, sump-type plants of 8 and 13 cubic feet per second capacities, an outdoor, flat-slab-type plant of 4 cubic feet per second capacity; and an indoor-type plant of 5-cubic feet per second capacity. Work will also include constructing about 4 miles of 15- to 36-inch reinforced concrete, pretensioned reinforcement (steel cylinder type) pipe, discharge lines, and trunklines. Sand Ridge, East Layton and Val Verde Pumping Plants, between Salt Lake City and Ogden.
Do	Earthwork and structures for about 15 miles of Uintah bench laterals of precast concrete pipe, modified prestressed steel cylinder pipe, mortar-lined and coated steel pipe and cast iron pipe or asbestos-cement pipe; 2 small reservoirs; and one pumping plant with 4 outdoor, horizontal booster units. South of Ogden.
Do	Constructing recreational facilities including access roads, culinary water system, irrigation ditch, boat ramp, fireplaces, shelters, restrooms and landscaping. At the Wanship Reservoir, 38 miles east of Salt Lake City.
Do	Constructing two 6-room brick veneer residences with floor spaces of about 1,180 square feet, full basements and a double garage, southeast of Ogden.
Yakima, Wash	Furnishing and installing traveling trashracks and conveyor in the forebay of the Chandler powerplant consisting of about 100,000 pounds of machinery parts and structural steel and some concrete work. Near Prosser.

*Subject to change.

MAJOR RECENT CONTRACT AWARDS

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DC-4914	Colorado River Storage, N. Mex.	Oct. 24	Construction of fifteen 3-bedroom residences and washhouse building; streets, driveways, and trailer park area; water, sewer, and electrical distribution systems; and power facilities for Navajo Dam government community.	Oehring Construction Co., Farmington, N. Mex.	$260,190
DC-4947	Rogue River Basin, Oreg.	Oct. 11	Construction of earthwork, concrete canal lining, and structures for Howard Prairie delivery canal, station 539+00 to 986+75; and Little Beaver Creek feeder canal.	Cherf Brothers, Inc., Sandkay Contractors, Inc., Cheney Construction Co., and S. Birch & Sons Construction Co., Ephrata, Wash.	1,285,057
DC-4948	do	Oct. 11	Construction of Keene Creek Dam and Green Springs power conduit, station 1+47.77 to 118+31.75, utilizing concrete cylinder pipe (pretensioned reinforced) or welded plate steel pipe in power conduit, schedules 1 and 4.	Cheney Construction Co., Cherf Brothers, Inc., Sandkay Contractors, Inc., Green Construction Co., and S. Birch & Sons Construction Co., Seattle, Wash.	2,894,330
DC-4951	Middle Rio Grande, N. Mex.	Oct. 17	Channelization of the Rio Grande, station 1400+00 to 1908+00, Socorro Area.	Reeder Construction Co., Albuquerque, N. Mex.	728,648
DC-4954	do	Nov. 6	Channelization of the Rio Grande, station 1908+00 to 1973+10, Socorro Area.	Boswell Construction Co., Albuquerque, N. Mex.	421,547
DC-4956	Ventura River, Calif.	Nov. 20	Construction of earthwork, structures, concrete or steel pipe lines, and access roads for Casitas Gravity, Oak View, Ojai Valley, Rincon, and other mains.	E. A. Irish, Los Angeles, Calif.	5,263,542
DC-4960	Eklutna, Alaska	Oct. 23	Relocation of Eklutna-Palmer 115-kilovolt transmission line using new materials, schedule 1.	Montgomery Electric Co., Portland, Oreg.	230,978
DC-4961	Yakima, Wash.	Nov. 1	Completion of Roza powerplant and switchyard	Power Line Erectors, Inc., Spokane, Wash.	121,531
DC-4962	Missouri River Basin, Wyo.	Nov. 29	Furnishing and installing two 25,263-kilovolt-ampere vertical-shaft generators for Fremont Canyon powerplant.	General Electric Co., Denver, Colo.	916,771
DC-4963	Columbia Basin, Wash.	Oct. 25	Construction of earthwork, concrete lining, and structures for Block 20 laterals, wasteways, and drains, Wahluke Branch canal laterals.	Donald M. Drake Co., Portland, Oreg.	1,320,620
DS-4968	Central Valley, Calif.	Nov. 8	One 16-foot diameter spherical intake bulkhead and one lot of embedded metalwork for outlet works at Trinity Dam, schedule 1.	Treadwell Construction Co., Midland, Pa.	112,368
DC-4972	Missouri River Basin, Nebr.	Dec. 11	Construction of earthwork and structures for Meeker extension canal, station 1563+15 to 2122+17.6; and laterals, wasteways, and drains.	M. & A. Construction Co., Superior, Nebr.	584,066
DC-4982	Middle Rio Grande, N. Mex.	Dec. 18	Construction of earthwork and structures for Atrisco feeder canal, north reach extension.	Boswell Construction Co., Albuquerque, N. Mex.	133,548
DC-4983	Gila, Ariz.	Nov. 27	Construction of a reinforced-concrete overchute over Wellton-Mohawk Canal, station 661+16; and repair of existing overchute, station 660+00.	Arrow Construction Co., Inc., Yuma, Ariz.	161,497
DS-4984	Ventura River, Calif.	Dec. 20	Three 2,400-volt and two 480-volt motor control equipment assemblies for Ventura Avenue Nos. 1 and 2, Rincon, Ojai Valley, and Upper Ojai pumping plants.	Electric Machinery Manufacturing Co., Minneapolis, Minn.	144,700
DC-4989	Colorado River Storage, Ariz.-Utah.	Dec. 10	Construction of two hundred 3-bedroom residences for Page, Ariz.	Page City Constructors (Mobilhome Corp., et al), Bakersfield, Calif.	3,157,580
100S-314	Minidoka, Idaho	Nov. 26	Eleven deep well pumping units for 11 wells in North Side Pumping Division.	Layne & Bowler Pump Co., Los Angeles, Calif.	140,308
200C-369	Ventura River, Calif.	Dec. 11	Clearing Casitas Reservoir site	V. J. Nielsen Construction Co., Parlier, Calif.	150,000
400C-96	Provo River, Utah	Nov. 21	Construction of earthwork and structures for Provo River channel improvement above Deer Creek Reservoir, mile 4.1 to 26.7.	The Contracting Corp., Salt Lake City, Utah.	177,620

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The Reclamation Era

MAY 1958

Official Publication of the Bureau of Reclamation

The Reclamation Era

MAY 1958 **Volume 44, No. 2**

In this issue . . .

J. J. McCARTHY, Editor

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by ROBERT K. HUCKINS
Chipman Chemical Co., Bound Brook, N. J.

Aquatic Weed Control in Lakes and Ponds

The problem of controlling overabundant aquatic plant growths is of major concern to many people; pond owners, fishermen, swimmers, boaters, farmers, water supply managers, industrialists, in fact, all users of water. Such growths, when abundant, may interfere seriously with the use of water for recreational purposes, for irrigation, for drinking, and for industrial manufacturing.

Aquatic plant growths may be classified for purposes of their control, into several main groupings:

1. EMERGENT: Water weeds usually rooted in shallow water, but most of the plant grows above the surface of the water. Examples of this group are the cattail, tule, water lily, alligator weed and pickerel weed. The water hyacinth is a floating emergent plant.

2. SUBMERSED: Rooted water weeds which grow for the most part under water from the bottom of a pond or river. This group includes sago and bushy pond weed, horned pond weed, bladderwort, fanwort and water milfoil. A considerable portion of the water milfoil known as parrot-feather grows above the water. Coontail is a submersed waterweed but is not rooted.

3. ALGAE: Free floating plants of small size appearing as scum or attached to objects in the water. Nuisance algae are generally of two types, pond scums or filamntous types, and single celled algae or water blooms.

Those confronted with aquatic weed problems have tried many ways of controlling these pests. The principal methods developed for lakes and ponds can be classed as biological, chemical or mechanical.

1. BIOLOGICAL: The use of plant eating animals as agents of aquatic weed control has been tried out without any real success except perhaps in specialized areas. While ducks and

Above Left: BEFORE TREATMENT: Pond is covered with scum algae. Above Right: AFTER TREATMENT: With Atlas "A"—a clean surface indicates complete control. ***All Photos in this Article Courtesy of the Chipman Chemical Co.***

muskrats do eat large quantities of plants, they do not eat enough to give good weed control.

The use of commercial fertilizers to stimulate the growth of single celled plants and animals called plankton, which in turn, because of their density, shade out underwater aquatic plants, is widely used for submersed weed control in small farm ponds. To be successful the plankton "blooms" must be maintained at a density heavy enough to shade out the other vegetation. Under this condition the water resembles "pea soup" in color, and as such, is not generally considered to be suitable for recreational use. The amount of fertilizer needed is about 100 pounds per acre and treatments may have to be repeated as often as every 2 weeks from spring to fall. The cost of material and labor involved is too great for the use of this method in larger bodies of water.

2. MECHANICAL: Mechanical methods include mowing, dredging, raking, burning, and crushing of the weeds. For limited areas, in private situations, such methods may be effective but are costly in labor. The treatment of larger areas by mechanical means is very expensive, both in terms of labor and equipment. The "harvesting" of the cut weeds is a major problem and if not done thoroughly, the cut fragments of the plants, having the ability to produce new roots, will serve to spread the nuisance.

3. CHEMICAL: The use of chemicals for the control of undesirable aquatic plant growths is by far the most satisfactory method. Considerable research and development work over a number of years has made several chemicals available that will serve to control aquatic plants in most situations.

Submersed Aquatic Plant Control

The old "tried and true" chemical for the control of submersed aquatic plants in lakes and ponds is sodium arsenite solution (See Editor's note.) It has been widely used for many years with consistently favorable results. As sodium arsenite is relatively nonselective in its effects on submersed aquatic plants it can be used for the control of almost all troublesome plant growths. It is usually applied as as pray mixed with water to the surface of the water area or it may sometimes be applied directly in diluted form to the exposed pond or lake bottom after draining.

To be most effective there should be almost no flow of water through the treated area for 2 to 3 days after water surface area application is made. In artificial ponds or impoundments it is often possible to lower the water levels prior to treatment so that no chemical will be lost over the spillway for this 2 to 3 day period after treatment while the pond is filling up.

The rate of application of Sodium Arsenite needed for the control of submersed aquatic plants in water treatments is from 4 to 10 ppm, depending on the size and exposure of the area treated. The term "ppm" (parts per million), as used here, is a weight definition meaning pounds of active chemical per million pounds of water. In this case, 4 to 10 ppm of arsenious oxide (AS_2O_3).

There are other new chemicals being developed for the control of submersed aquatic plants that hold some promise for the future. Until such a time that these become available, sodium arsenite remains the most effective and most reasonable in cost of any chemical available today.

ALGAE: There are four chemicals available to date that are specifically recommended for the control of algae.

Copper sulphate has been used for years for this purpose and is effective on many types. A rate of 0.3 to 1.0 ppm is generally used. The amount will vary directly with the hardness of the water.

Sodium arsenite is effective as an algicide as well as a herbicide and is relatively nonselective in its actions. It is used principally for the control of pond scums or filamentous types. The recommended rate for algae is 2.5 ppm.

Among the newer materials are rosin amine D acetate and dichlone (2,3-dichloronaphthoquinone). These two compounds are more selective than copper sulphate and in many instances, more effective. Another advantage of these materials is that they are generally less harmful to fish food organism than is copper sulphate. Rosin amine D acetate is to be recommended especially for the filamentous, scum and mat-forming algae while dichlone is more effective on the single celled "bloom" types.

Rosin amine D acetate is used at rates of 0.3 to 1.0 ppm, depending on water temperatures; the warmer the water the lower the rate needed.

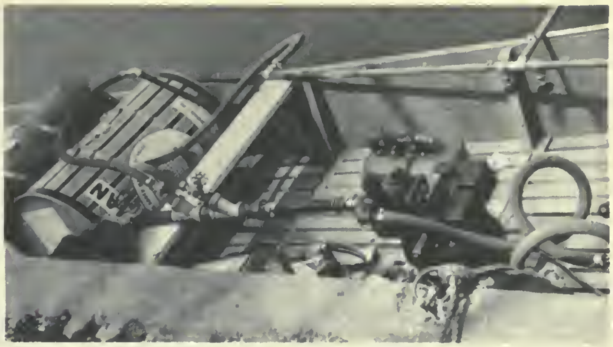
Dichlone is effective against algae at the rates of 0.05 to 0.15 ppm.

Emergent Aquatic Plants

Control of most of the plants found in the emergent group is best achieved with 2,4–D. The low volatile esters or the amine formulations are to be preferred, for with these, there is less danger to adjacent valuable plants.

The recommended rate of 2,4–D for *emergent aquatic* plant control is a 0.5 percent solution using 100 to 200 gallons per acre. For small ap-

AQUATIC WEED PROBLEMS in fresh water lakes—Water lilies, Parrot feather, and Algae.



Typical power spray equipment.

plications, 8 fluid ounces of a 4-pound formulation mixed with 5 gallons of water gives about a 0.5 percent mixture. To make this solution, use 1 gallon of 2,4–D formulation (containing 4 pounds of 2,4–D acid per gallon) to each 100 gallons of water.

Shoreline brush and woody plants can also be controlled with the 2,4–D, 2,4,5–T type Brush Killers. These are used at the same rates and in the same manner as is 2,4–D when used for emergent aquatics.

Recently two newer compounds have come into use for the control of cattail (Typha) and reed grass (Phragmites).

Both dalapon (2,2–dichloropropionic acid) used at 25 to 40 pounds per acre and amino triazole at 5 to 10 pounds per acre are effective in controlling these weeds. A combination of these two has shown real promise in test work.

Application of Chemicals and Equipment Needed

The equipment needed for the application of the chemicals mentioned may be quite simple, e. g., a closely woven bag or a high pressure power sprayer. Copper sulphate is often broadcast over the water in the form of fine crystals. Dichlone is available as a wettable powder and rosin amine D acetate as a heavy thick paste or as a liquid. The first two materials, and also copper sulphate may be placed in a closely woven bag and dragged through the water in the area to be treated. Dichlone and rosin amine D acetate may also be applied as a spray over the surface in the same way as sodium arsenite. For small area spray applications, say up to 3 acres or so, a 5-gallon tank type sprayer may be large enough. The chemicals are diluted with enough water to give adequate coverage of the treated area. More time will be required to do the work with small equip-

ment but the savings over heavy equipment costs may justify the extra time required.

For larger areas power equipment is desirable. Most satisfactory is a centrifugal pump powered with a gasoline engine. Pumps of 1 to 1½ inch size are adequate. The intake line is divided so that dilution water may be drawn from the pond or lake at the same time the chemical is being taken from the shipping drum or spray tank. The output side of the pump is connected via a hose equipped with regulatory valves to a spray boom extended past the stern of the spray boat. A branch "takeoff" hose line to a spray nozzle for reaching shallow and hard to reach areas is helpful.

The boat used for such work should be of rugged construction and powered with an outboard motor for ease in maneuverability.

The agricultural chemical industry is well aware of this national and international problem of overabundant aquatic plant growth. The search for new and more potent and less expensive chemicals is going on steadily. State and Federal Fish and Game Agencies and Experiment Stations are continually testing these new chemicals as they are being developed by industry. The public faced with waterweed problems will surely benefit from these research programs. Pictures of "BEFORE" and "AFTER" treatment, courtesy of E. F. Kennamer, Fish and Wildlife Specialist, Agricultural Extension Service, Auburn, Ala.

For the control of cattails the Bureau of Reclamation uses the Department of Agriculture's suggested recommendation of: 4 to 6 pounds of a low volatile ester of 2,4–D and a 1 to 20 oil-water emulsion (1 gallon diesel oil to 20 gallons of water) using a total volume of 150 to 300 gallons of the emulsion per acre of cattail plants. The first spraying should be done just before the cattail heads form and repeated as necessary, usually about 3 applications over a 2-year period for complete elimination. # # #

Editor's Note: As a safeguard to themselves, to others and to livestock, only persons experienced in the use of arsenic compounds and who thoroughly realize their poisonous nature should undertake to apply them. It is the policy of the Bureau of Reclamation not to use arsenicals in irrigation water.

DOMINY NAMED ASSOCIATE COMMISSIONER

Secretary of the Interior Fred A. Seaton recently announced the appointment of Floyd E. Dominy as Associate Commissioner for the Bureau of Reclamation.

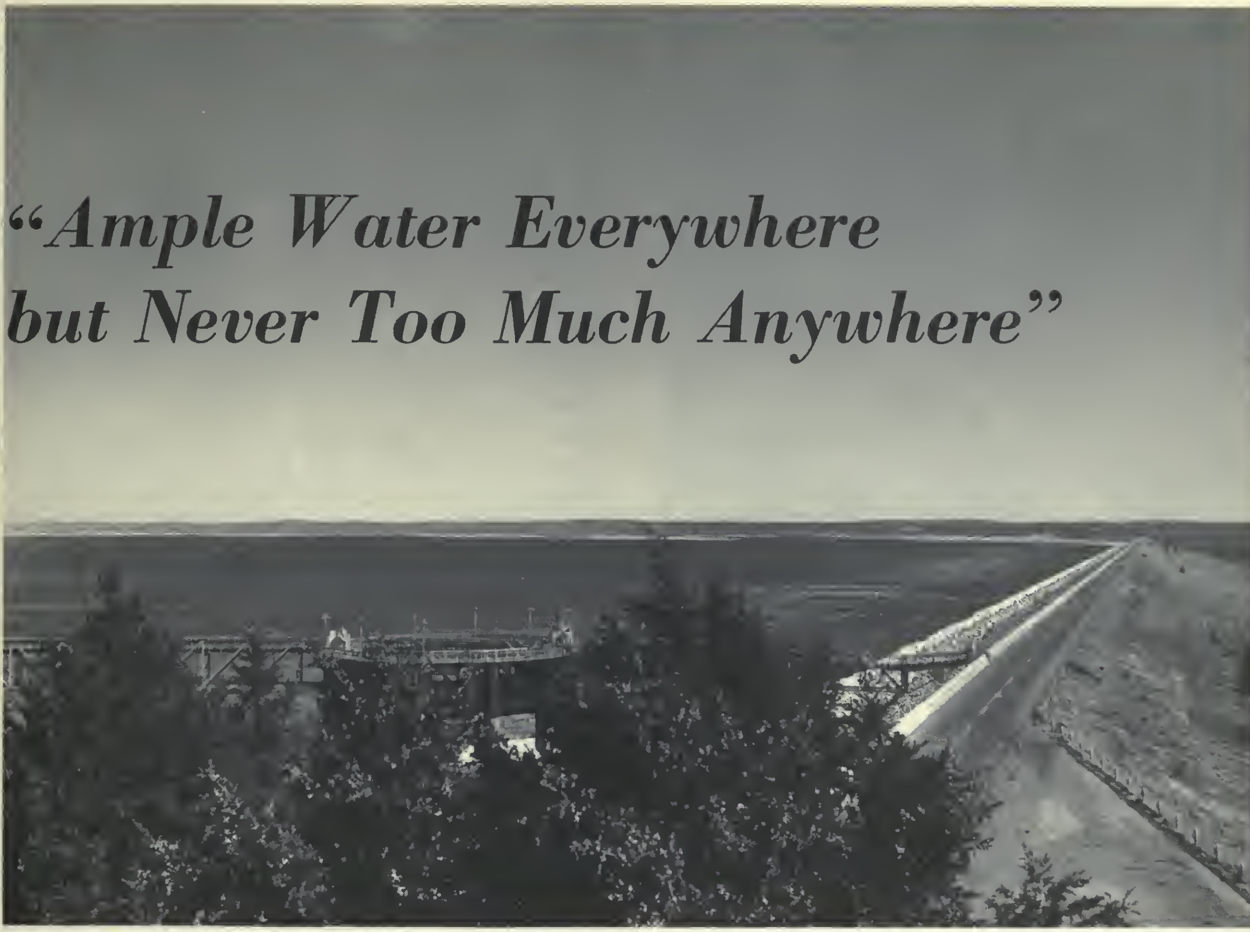
Mr. Dominy, who has been with the Bureau of Reclamation for 11 years, served as Chief of that agency's Division of Irrigation from 1953 until August 1957 when he was named Assistant Commissioner.

Secretary Seaton said that Mr. Dominy, in the new position, will be second in authority to W. A. Dexheimer, Commissioner of Reclamation. He will also have overall charge of policy and program execution pertaining to the functions of the irrigation, power, project investigations, and budget considerations, in addition to his present responsibility for Bureau legislative affairs.

"The creation of the new Office of Associate Commissioner and the selection of Mr. Dominy to fill that position will greatly assist the Bureau of Reclamation in carrying forward its important program," Secretary Seaton said.

Mr. Dominy joined the Bureau of Reclamation in April 1946, as chief of the Allocation and Repayment Branch of the Operation and Maintenance Division. He became assistant director of the Division in 1950 and director in 1953. Under the Bureau's reorganization in December 1953, he became chief of the Division of Irrigation. #

"Ample Water Everywhere but Never Too Much Anywhere"



KINGSLEY DAM AND LAKE McCONAUGHY. ***All photos in this article courtesy The Central Nebraska Public Power and Irrigation District.***

Having at all times enough water everywhere and never too much anywhere is the secret of operating an irrigation system without wasteways. And when the system is as extensive as that of The Central Nebraska Public Power and Irrigation District it takes a lot of planning and close attention to the details of operation and water management to accomplish that end. But here in semi-arid Central Nebraska limited water supplies make close scheduling imperative—and hence wasteways unnecessary.

The Central Nebraska District brings water to 112,000 acres of land in Gosper, Phelps and Kearney counties in south central Nebraska, by means of three canal systems: The Phelps County Canal, 56.7 miles in length with 284 miles of distribution laterals, irrigating 72,786 acres; the E–65 Canal, 54.7 miles in length with 199 miles of distribution laterals, irrigating 33,484 acres, and the E–67 Canal, 9.34 miles in length with 15 miles of distribution laterals, irrigating 5,731 acres.

On these 120.74 miles of main canals and 498 miles of distribution laterals there are no wasteways and only five emergency spillways, which in 17 years of operation have been used only four times and then only because of heavy local rainfall. Even such flood conditions can be usually guarded against. Weather bureau reports, together with the districts own weather station at Holdrege, and readings by patrolmen made on 46 rain gages on the canals are used to anticipate heavy precipitation and excess accumulations, and the 120.74 miles of main canals are blocked into sections by structures making these sections, by careful scheduling, available to store excess flood water. Good water management and careful scheduling, even on a system as extensive and

by STANLEY A. MATZKE, Assistant to the Manager
The Central Nebraska Public Power and Irrigation District, Hastings, Nebr.

OVER 600 MILES OF CANALS AND DISTRIBUTION LATERALS comprise the irrigation system of the Central Nebraska Public Power and Irrigation District which irrigates 112,000 acres.

complicated as this, can eliminate the necessity of dumping water except in rare unforeseen emergencies.

Operation of the system is supervised out of the Central Nebraska District's Holdrege Irrigation headquarters with area supervision offices at Holdrege, Minden, and Bertrand. During the irrigation season 21 patrolmen handle the deliveries, 7 on the 38,982 acres handled out of Holdrege, 8 on the 39,215 acres handled out of Bertrand, and 6 on the 33,804 acres handled out of Minden. Patrolmen travel in pickup trucks equipped with two-way short wave radio by which they can talk to each other, to the base stations at Holdrege, Minden, and Bertrand, and to the maintenance crews. An irrigation superintendent and a water clerk are permanently maintained at each of these three offices and are responsible to the irrigation engineer at the Holdrege headquarters. Employees, including all patrolmen, are on a full time, year around work basis, and are kept busy during the nonirrigation season with maintenance, repairs, shop work and making out water schedules.

But to get the picture of the setup by which approximately a quarter million acre-feet of water is handled each year without wasteways it is necessary to go back several months before the patrolmen begin opening the turnouts at the irrigators' farms; that is back to the first week in February prior to the beginning of the irrigation season in the first part of April.

It is then that the 12-member board of directors makes an official determination of the amount of water available for the coming season. The Central Nebraska District is not obligated by its contracts with its irrigators to deliver any specific amount of water, but only the pro rata share to each acre of the total available each year as determined by the board of directors. This can vary from year to year and in years of ample storage in The Central Nebraska Districts 2 million acre-feet capacity reservoir Lake McConaughy extra water is delivered with the approval of the board, especially in the spring and fall when stream flow is heavy and can be utilized in place of storage water.

After the determination of the amount of water available the board approves a scheduling of water rate deliveries for the approaching irrigation season. Until 1955 the schedule was on the basis of a minimum of 1 acre-foot per acre at the farm turnout divided into seven runs—21 days apart. Enlargements on the canal system completed that year make it possible for water users who desire it to obtain 1½ acre-feet per acre on the Phelps County Canal and on the E–67 Canal. Where 1½ acre-feet per acre is available the scheduling is on the basis of 11 runs 14 days apart, except on E–67 where the irrigators prefer 7 runs 21 days apart. The rate charged is $3.75 per acre for the 1½ acre-feet delivery and $2.50 per acre for the 1 acre-foot per acre delivery. The 1957 delivery was 1½ acre-feet, delivered at

Water being released from Lake McConaughy for use through three hydroelectric powerplants for irrigation on approximately 250,000 acres of Platte River watershed lands from Keystone to Kearney.

the water users turnout, to 73,649 acres and 1 acre-foot to 38,095 acres. Following is a typical water rate delivery schedule as approved by the board:

Runs	Phelps Canal	$3.75	$2.50	E-65 Canal	$2.50	E-67 Canal $3.75
1	4/16-6/4	0.25 af	0.25 af	4/16-6/11	0.25 af	0.25 af
2	6/4-6/18	.18	.09	6/11-7/2	.18	.30
3	6/18-7/2	.18	.11	7/2-7/23	.18	.30
4	7/2-7/16	.18	.11	7/23-8/13	.18	.30
5	7/16-7/30	.18	.11	8/13-9/3	.18	.30
6	7/30-8/13	.18	.11	9/3-9/24	.18	30
7	8/13-8/27	.18	.11	9/24-10/15	.18	.30
8	8/27-9/10	.18	.11	Total af per acre.	1.33	2.05
9	9/10-9/24	.18	.11			
10	9/24-10/8	.18	.11			
11	10/8-10/22	.18	.11			
	Total af per acre.	2.05	1.33			

Left: HEADGATE of Phelps County Canal. Center: Board of Directors of Agriculture Committee (from left) Frank Cole, a pump irrigation well driller, Winford Bossung, a farmer, Morits Aabel, an insurance agency manager, J. R. McBride, a feed manufacturer and alfalfa dehydrator operator, and Ben H. Bracken, a lawyer. Right: PATROLMEN CHANGING DIVERSION.

After the adoption of the delivery schedule by the board of directors each of the three area offices begins making up schedules for the patrols under its supervision, and each superintendent with his water clerk and patrolmen makes up the schedule for each water user on each patrol. The acreage entitled to water on each farm and on each patrol has been predetermined by the irrigation superintendent and water clerk and the total amount of each run on each patrol is determined by multiplying the amount of each run as shown by the delivery schedule by the number of acres in the patrol. This then divided by the 14 or 21 days gives the amount of water needed on the patrol each day. The patrolman and water clerk then figure from past experience the amount of water which will be lost by seepage and evaporation and add this to obtain the amount of water needed each day at the patrol diversion. Variations in weather conditions make these estimates subject to day to day changes which it is the patrolman's duty to anticipate and report.

Each area water clerk makes up a Water Record showing the name of the water user, a description of the land, the number of acres to be served, the acre feet of water to be available for each run and the date thereof. Each water user is mailed a card listing this information with the admonition, "Keep this card to remind you of your water delivery dates for this year." Most water users hang the card near the telephone where it serves as a daily reminder and his work and social calendar are geared to its demands.

Each patrolman gets a complete copy of the Water Record so far as it concerns his patrol and also a Route Card for each account on his patrol. These are size 4½ by 7 inches and carried in a loose leaf binder and thereon he keeps a record of each delivery throughout the season. This looseleaf book also carries his Water Delivery Report blanks of the same size to report each individual delivery to the area office. These are posted on the Water Record and on a Daily Summary Report which is sent each day to the Holdrege headquarters where an overall daily summary is kept from which diversions at all points can be totaled.

A water user can turn down any run by giving sufficient notice to the patrolman or the area office. It is standard procedure that the patrolman contact each water user 2 days prior to the date set for each run and in case he desires no water he signs a Water Shut Off Notice. In case the water user is a tenant the landowner is notified of the water refusal by post card.

The overall water management of the Central Nebraska District is under the supervision of its Hydraulic Engineer at its Hastings headquarters who supervises the release of water from Lake McConaughy which gets 80 percent of the inflow from return flow from irrigation from Bureau of

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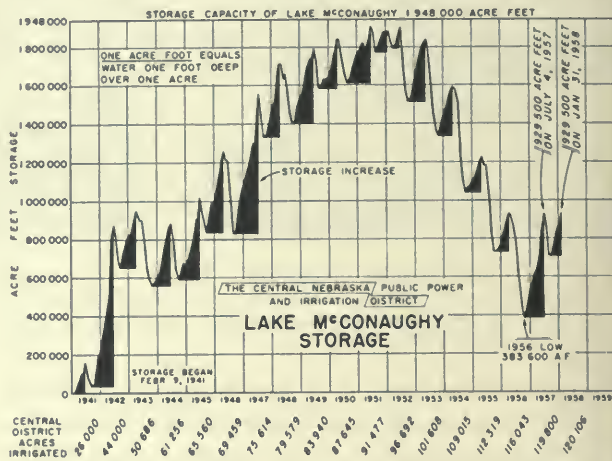
SCHEDULING OF ANNUAL WATER DELIVERIES. Meeting at Holdrege Irrigation headquarters are (standing from left) Assistant General Manager Jack W. Boyd and Irrigation Engineer L. G. Mathieu, and (seated from left) Irrigation Superintendents, Orvin Marquardt of the Bertrand office, William Cronin of the Minden office and Martin Waller of the Holdrege office.

Reclamation reservoirs up the North Platte River in Wyoming; its diversion at the Keystone diversion dam to the supply canal of the Platte Valley Public Power and Irrigation District for operation of its 26,000 kw. hydroplant, from where it is returned to the South Platte River; its diversion at the North Platte diversion dam to the Central Nebraska District's 75-mile-long supply canal on which 8,105 additional acres are irrigated by pumping from the canal and three 18,000 kw. capacity hydroplants are operated, and finally its diversion to the head gates of the irrigation system's three canals as herein described.

This management includes the bypassing down the river at the Keystone diversion of natural flow and supplemental storage water for 6 on-river canals between there and North Platte, the return to the river of natural flow and supplemental storage water at the upper (Jeffrey) hydroelectric plant for the 6 on-river canals between there and Lexington and the return to the river at the Johnson No. 2 hydroelectric plant of natural flow and supplemental storage water for the 2 on-river canals below Lexington.

The Central Nebraska District furnished these on-river canals supplemental storage water up to 125,000 acre-feet each year. The irrigation division management must be closely coordinated with this overall management to the end that full beneficial use is made of every drop of water—so that, like the irrigation division, there is ample water everywhere but never too much anywhere.

Management within the framework of the irrigation division's more or less rigid system still allows room for considerable flexibility as water users with the cooperation of the patrolman change run dates and often, as in the early part of the season, are given considerable leeway as to when they take their early runs. But when the chips are down in the heat and drouth of July and August rigid adherence to the system assures that there will always be enough water everywhere and never too much anywhere. And if there is never too much anywhere you just don't need wasteways, although sometimes when the patrolmen are fighting accumulations from local rains they have to do some mighty fast water juggling.



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WOMEN VOLUNTEERS WANTED FOR ERA

The Secretary or some other officer of each and every organization of women on our projects is requested to take her pen or typewriter in hand and write to J. J. McCarthy, Editor of Reclamation Era, *and outline her views as to how the* Era *may best serve the interests of our project women. The same invitation is extended to every woman not connected with a women's organization.*

The Era *wishes to be of service to everyone on the projects—men, women, boys, and girls. Just now the call is for women volunteers; without whose cooperation this proposed feature of the* Era *cannot be a complete success.*

Write today!

Zinc Deficiency in the Irrigated West

Do you have stunted corn with broad white stripes on the lower leaves? Or do you have yellowish-brown patches of stunted beans showing severe chlorosis on the lower leaves soon after they come up? If you do, then chances are that your crop may need zinc.

Zinc deficiency is being noted in more and more areas in the irrigated West. Back in the 1920's, "mottle leaf" on citrus and "rosette" or "little leaf" on deciduous fruits were observed in many areas where these crops were grown. It was particularly bad on old corral areas. Research showed that it could be corrected by the application of sprays containing zinc and that zinc was an essential element for growth. Use of zinc sprays in orchards and groves became a common practice in most fruit-growing areas. Then, in 1950, the author showed that a deficiency in corn and beans in the Columbia Basin and Yakima projects in Washington could be corrected by the application of zinc sulfate sprays. Later research showed that a large number of crops including grain sorghums, onions, alfalfa, hops, grapes, lime and field beans, Sudan grass, soybeans, and castor beans were susceptible to the deficiency.

At about the same time, growers in the Salinas Valley, Calif., started applying zinc sulfate sprays to improve the foliage color and hasten maturity of beans. Later work in California by Dr. John C. Lingle has shown that a number of vegetable and field crops are affected by zinc deficiency in the valleys of California. In North Dakota, severe symptoms of zinc deficiency on corn have been noted where surface soil is removed in the leveling of land for irrigation. In 1954, zinc deficiency on beans and corn was found to be rather widespread in the North Platte valley irrigated areas and in other parts of western Nebraska. In 1957, severe zinc deficiency and stunting of corn was noted in the Prospect Valley of eastern Colorado. The available evidence indicates that areas showing zinc deficiency in crops are rapidly spreading in the irrigated West and that farmers must be prepared to cope with the situation.

Not very much is known about the soil conditions which produce zinc deficiency. A 3,000-pound dry bean crop contains only about one-tenth pound of zinc, yet beans are unable to get this amount of zinc from a soil that often contains as much as 300 pounds of zinc in the surface foot of an acre. Available zinc is generally higher in the surface soil where the organic matter is lo-

by F. G. VIETS, JR., Soil and Water Conservation Research Division, Agricultural Research Service, U. S. Department of Agriculture, Fort Collins, Colo.

cated and declines rapidly with depth. Hence, removal of surface soil by erosion or by leveling for irrigation will frequently induce zinc deficiency. Both the availability of the native and applied zinc is affected by the soil reaction or acidity. The more acid the soil, the more available the zinc becomes. Zinc can be made more available by the use of sulfur or acid-forming fertilizers like ammonium sulfate. However, changing the soil acidity is not a practical method of increasing the available zinc supply.

In Washington, where zinc deficiency has been particularly severe on hops, corn, Netted Gem (Idaho Russet) potatoes, and onions, application of 10 pounds of zinc per acre broadcast or sidedressed every 3 or 4 years is now recommended. Hops need 20 to 30 pounds per acre. Though other crops are sensitive to zinc deficiency, zinc remains available in the soil over a considerable period and so this periodic application is sufficient to take care of the zinc needs of all crops in the rotation. Zinc cannot be leached from the soil by rain or over-irrigation. In Nebraska, the same recommendation is now made for control of the deficiency in beans and corn. In Washington, sprays of zinc sulfate were used before soil applications were recommended, but now it appears that sprays should be used only as an emergency method of control. For spraying, a solution of about one-half percent zinc sulfate is used and foliage of the entire plant is wetted. Because 50 to 100 gallons of spray per acre are required, aerial application has not proven feasible.

In California, soil applications have been suggested, but rates above 100 pounds zinc per acre have been required to achieve correction. Therefore, foliage applications are recommended.

Research in Washington has shown that any material which contains zinc in a form soluble in acid is a satisfactory source for soil application. Zinc sulfate and a byproduct of the smelting industry have been cheap and effective sources. The rates suggested here are for elemental zinc and should be corrected for the zinc content of the material used.

There are many puzzling problems yet to be solved. In California, sugar beets have been one of the most responsive crops to foliage applications of zinc spray. However, in Washington sugar beets have rarely shown evidence of zinc deficiency or response to zinc sprays or fertilizers. In both Washington and Nebraska, zinc deficiency on crops is much more severe following sugar beets than any other crop. The reason for this is not known, but some have suggested that it may be due to the fact that phosphate is generally applied to beets. On tree fruits there have been many instances where phosphate application induced zinc deficiency, but with Washington soils application of phosphate had no affect on availability of native or applied zinc for corn or beans.

At Left: Zinc deficient onions. At Right: Zinc deficiency on beans. All Photos in this article courtesy of the Author.

There are other puzzling problems. In Washington, the Netted Gem variety of potatoes (called Idaho Russet or Russet Burbank in other places) will often show a peculiar stunting and twisting of the terminal growth. Sidedressing zinc fertilizers or spraying zinc sulfate on the foliage

Continued on page 50

L. N. McClellan

Grant Bloodgood

Alfred R. Golzé

E. G. Nielsen

William I. Palmer

Donald S. Mitchell

KEY PERSONNEL CHANGES

Changes in top administrative posts in the Bureau of Reclamation's Washington and Denver offices as the result of the retirement of Assistant Commissioner and Chief Engineer L. N. McClellan and Assistant Commissioner S. W. Crosthwait have been approved by Secretary of the Interior Seaton on the recommendation of Reclamation Commissioner Dexheimer.

The changes are:

Grant Bloodgood, formerly Associate Chief Engineer, to Assistant Commissioner and Chief Engineer in Denver.

Alfred R. Golzé, formerly Chief of the Division of Program Coordination and Finance, to Assistant Commissioner in Washington, with primary responsibilities for administrative functions.

E. G. Nielsen, formerly Assistant Commissioner in Washington, to Associate Chief Engineer in Denver.

These, with Commissioner Dexheimer and Associate Commissioner Dominy, complete the top Executive Staff of the Bureau.

William I. Palmer has been named Chief of the Division of Irrigation, succeeding Mr. Dominy,

and Donald S. Mitchell has been named Assistant Chief, succeeding Mr. Palmer.

MR. McCLELLAN, a native of Middletown, Iowa, is a veteran in years of service with the Bureau of Reclamation. Upon receiving his B. S. degree in electrical engineering from the University of Southern California in 1911, he joined the Bureau of Reclamation as Superintendent of Power on the Salt River project.

He served as a first lieutenant in the United States Army during World War I, returning to the Bureau, after his discharge, as assistant electrical engineer at Denver. He has worked for the Bureau continuously, with the exception of a brief term with the Southern California Edison Co., holding many top ranking positions. He has served as Chief Electrical Engineer, Assistant Chief Engineer, Chief Engineer, and Director of the Branch of Design and Construction. He held this latter post when appointed to his present position.

Mr. McClellan is a member of the American Institute of Electrical Engineering and the American Society of Civil Engineers. He has also been very active in international professional affairs and is a committee member of the International Conference on Large Electric High Tension Systems. He has received many honors in recognition of his work. The Department of the Interior bestowed its highest award, the Gold Medal Award for Distinguished Service, on him in September 1952. In 1951 he was presented the Gold Medal Award for Distinguished Service by the Colorado Engineering Council to become the fifth recipient of the award in the 25 years of its existence. The honorary degree of Doctor of Engineering was conferred upon him in 1949 by the University of Colorado. This year he was presented the Golden Beaver Award by the Beavers, an organization of construction and equipment companies and men who have built dams and other large structures in the western United States.

Mr. McClellan is a member of Sigma Xi, honorary scientific fraternity, and Tau Beta Pi, honorary engineering fraternity. He is a Fellow and Life Member of the American Institute of Electrical Engineers; member of the American Society of Civil Engineers; member and past vice president of the Colorado Society of Engineers; member of the International Conference on Large Electric High Tension Systems (C. I. G. R. E.); member of the United States National Committee of the International Commission on Irrigation and Drainage; and member of the United States Committee of the International Commission on Large Dams.

MR. BLOODGOOD was first employed by the Bureau in 1920. He received his degree in engineering from the University of Nebraska in that year and immediately went to work for the Bureau of Reclamation on the North Platte and Riverton projects in Nebraska and Wyoming. He was in private engineering work from 1925 to 1929, including the location and construction of a canal and lateral system for a 40,000-acre irrigation project in Mexico. He returned to the Bureau of Reclamation in 1929, working on the Riverton project and later going to the Boulder Canyon project where he was in charge of layout and estimates during construction of Hoover Dam and Powerplant. He was, successively, Resident Engineer for construction of the All-American Canal, Calif., the Gila Project, Ariz., and the Central Valley project, Calif.

He saw military service with the Corps of Engineers in both World Wars I and II.

Returning to the Bureau of Reclamation as Chief of the Construction Engineering Division in Denver in 1946, he later became Assistant Chief and then Chief Construction Engineer. He has been Associate Chief Engineer since January 1954.

He is a member of the American Society of Civil Engineers, Society of American Military Engineers, American Concrete Institute, and United States Committee on Large Dams. He was awarded the Interior Department Gold Medal for Distinguished Service.

MR. GOLZÉ is a career Federal employee with 28 years of service, including 23 with the Bureau of Reclamation. He will be responsible for general administrative detail, including contract administration, programs, finance, personnel, and management. He had previously been Chief of the Division of Program Coordination and Finance.

Mr. Golzé is a native of Washington, D. C., and a graduate in civil engineering from the University of Pennsylvania. He is presently vice president of the National Capital Section of the American Society of Civil Engineers and a member of the National Committee on Engineering Education of ASCE.

He began his public career as a Junior Civil Engineer in the Interstate Commerce Commission in 1930, and transferred to the Bureau of Reclamation as a Design Engineer in the Denver Office in 1933. He was responsible for all Civilian Conservation Corps activities in the Bureau in the late 1930's, and in 1943 went to the Bureau of the Budget in San Francisco.

In 1945, he returned to the Bureau of Reclamation as Assistant Director of the Branch of Operation and Maintenance. He was made Director of the Program and Finance Division in 1947.

MR. NIELSEN, first employed by the Bureau in 1934, obtained his B. S. degree in engineering from the University of Iowa in 1926. After working with private utilities and the Public Service Commission of Missouri, he joined the Bureau of Reclamation as Assistant Engineer in Denver in February 1934. In May 1936 he was promoted to Associate Engineer and in June 1938 became Planning Engineer at Salt Lake City, Utah.

He returned to the Denver office in 1942, and in January 1945 became head of the Hydrology Division. Subsequently, in 1945 he became Regional Planning Engineer at Boulder City, Nev., for the Lower Colorado River area. He became Assistant Regional Director at Boulder City in 1950, and in 1952 he was promoted to Regional Director. He has been Assistant Commissioner of the Bureau of Reclamation since 1955.

Mr. Nielsen is a member of the American Society of Civil Engineers and of Theta Tau fraternity.

MR. PALMER, Chief of the Division of Irrigation, has been with the Bureau of Reclamation since November 1944. He has been Assistant Chief of the Division of Irrigation since January 1956—while serving at the same time as Chief of the Contracts and Repayment Branch of that Division, following his appointment in October 1953. Prior to coming to Washington, Mr. Palmer served in the Bureau's Salt Lake City and Sacramento offices. He has also served with the Soil Conservation Service and other Department of Agriculture agencies in Utah, New Mexico, Arizona, Colorado, and California. He received his B. S. degree in agricultural economics from Utah State Agricultural College at Logan.

MR. MITCHELL has been Chief of the Land and Water Branch of the Division of Irrigation, since September 1950. He is a native of Colorado, and has been with the Bureau since June 1936. His experience covers several years with the Bureau as Irrigation Manager of the South Platte River District in Colorado and a tenure in administration in the Washington Office since 1950. As Irrigation Manager he was responsible for all agricultural activities, such as land classification, economics, and repayment determinations.

Mr. Mitchell received his B. S. degree in agriculture from the University of California.

As this issue went to press, Secretary of the Interior Fred A. Seaton announced the appointment of BRUCE G. DAVIS as Chief of the Bureau's Division of Program Coordination and Finance.

Mr. Davis, a career employee with the Bureau, was Chief of the Programs Branch of the Division at the time of his appointment.

Adventure in the Glen Canyon of the Colorado

The trip through Glen Canyon was not an adventure in the normal sense of the word. There was no physical risk involved in the boat trip that was made from Hite to Lees Ferry. Rather, it was an adventure into an awesome land where geologic turmoil and serene beauty join in close harmony, a rugged country that still conceals much of the history of a prehistoric Indian existence, and a sometimes turbulent, sometimes placid river that twists and turns in directions prescribed by high and sheer canyon walls. It was an adventure into the past. Except for modern equipment and utensils that were taken along on the trip, it was an almost complete, though temporary, retreat from civilization.

The Colorado is a river of many moods. In some places it is angry and tempestuous. In others, it is cool and placid. Sometimes it races along as if on a mission. Then again it will subside to a lazy lapping. It can make man fear or it can soothe him with a monotonous swish. It can stir excitement and then again the deafening roar of the water in the deep canyons will breed a peculiar melancholia. It is unpredictable. It is beautiful.

The Glen Canyon reach of the Colorado River has rugged beauty in the canyon walls that reach 2,000 feet into the sky to forbid passage except in one direction—down the river. It has mysterious beauty—of hidden canyons and passages, caves and grottos, of red sandstone spires and arches and fantastic shapes that change with the moving sun. It has beauty beyond comprehension. Man cannot adequately copy or portray it. But he can absorb it. We did.

We pushed our two rubber rafts in at Hite, an old mining settlement approximately 145 miles upstream from the Glen Canyon Damsite. There were ten in the party which included engineers, zoologists and botanists, a mammalogist, a photographer and two expert river-runners. The red mud was knee-deep and gooey as we climbed aboard and shoved off on our trek down the river. Flash floods and cloud bursts during the previous

by STAN RASMUSSEN, Regional Photographer, Region 4, Bureau of Reclamation, Salt Lake City, Utah

This Canyon appropriately called "Hidden Passage" is one of the many deep and narrow alleyways leading off the Colorado River.

THE

week had left the river extremely muddy and the banks so soft that almost every landing was like walking off into quicksand. It was the only inconvenience to spoil the perfection of the ride down the Colorado.

The purpose of the trip was to plan a scientific study of the area to be inundated by the reservoir of the Bureau of Reclamation's Glen Canyon Dam. Many experts in the field of natural science are in the area working on this project and will complete their studies before the rising waters fill the Glen Canyon. This particular group from the University of Utah included Drs. Woodbury, Durrant, Flowers, Cottam, and Grundman. Representing the Bureau of Reclamation were engineers Herb Riesbol, Denver, and Don Barnett, Salt Lake City, and the author. The river runners were Jack Brennan and Reed Jensen. There is much that must be learned about the reservoir area before it is flooded. These men were contributing their efforts to that end.

It required many stops each day. They were all the same. One or two of the men would take off in a zig-zag course following the tracks of rodents or muskrat or some other animal. Others would wander off in pursuit of plants and vegetation that they would preserve between pieces of

DR. ANGUS M. WOODBURY, Professor Emeritus of Zoology, University of Utah, Inspecting Indian pictographs.

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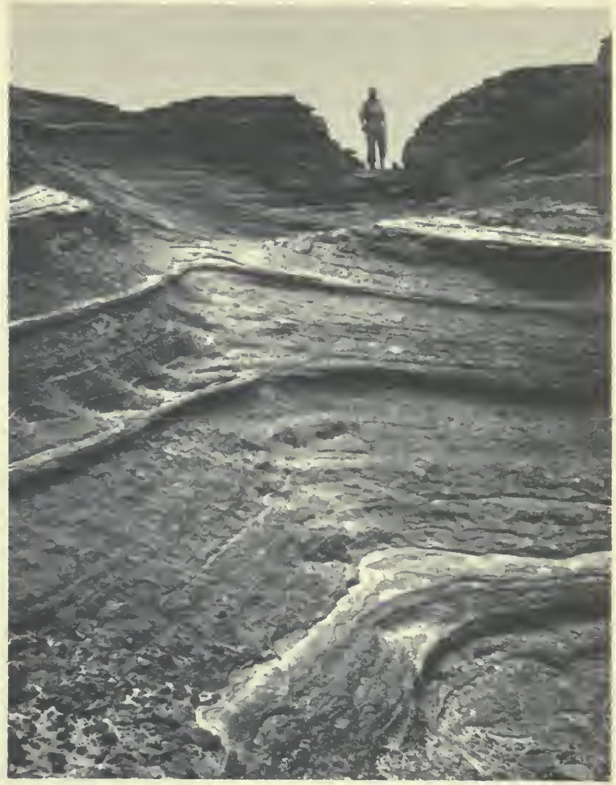


CROSSING OF THE FATHERS. At this point in 1776 Fathers Silvestre Valez de Escalante and Francisco Dominguez carved steps in the Navajo sandstone to aid their horses in the descent to the Colorado River. Reed Jensen of Salt Lake City is shown at the top of the steps.

cardboard and cushions of news print for future analysis in the laboratory. Then another would set about capturing little bugs and insects and stuffing them into small bottles containing alcohol or formaldehyde.

Someone would spot a chuckawalla lizard, which would be pursued with a long strip of rubber cut from an innertube. Curiosity would be the end of Mr. Lizard's freedom as the taut rubber band was released to whop him in the belly, stunning him long enough for the hand of an agile zoologist to close around him. A rattlesnake sleeping under a bush didn't wake up soon enough and was introduced to a white cloth bag as another specimen. And so it went. It was exhausting work slogging through the mud, or up the side of steep canyon walls and warily working back down again, or up sloppy creek beds and through underbrush.

But there were compensations. When the boats had been turned into the banks for the last time after the day's run, it wasn't long until the aroma of coffee would waft through the balmy night air and magnetically pull the party close to the roaring campfire. The stew and dutch-oven biscuits

REED JENSEN and JACK BRENNAN, river runners, walking up Bull Frog Creek in about a foot of mud.

were as tasty as steak and gravy. Then in the light of the full harvest moon there was the conviviality which attends every campfire. And when the talk was done, there came sleep that was deep and satisfying.

The next day would begin with a renewed vigor as the party set out to learn more of this fabulous canyon. History had been here. It was written on the canyon walls.

There are the steps that had been cut in the sandstone by the small party lead by Fathers Escalante and Dominguez in 1776 to assist their animals to the bottom of the canyon. They were returning to Santa Fe, N. Mex., after an unsuccessful attempt to find a direct route to the Presidio of Monterey in California.

And there is a gaping cleft high on the canyon rim where courageous Mormons had blasted an access for their wagons and sent them rumbling in a perilous descent down the canyon to the Colorado River. Today, this is known as the "Hole-in-the-Rock." They crossed the river and headed on into southeastern Utah to found a new settlement near what is now Bluff, Utah.

Then, too, there were the signs left by Major John Wesley Powell. This one-armed ex-artillery officer had led two expeditions (1869–72) down the river—the first expedition for 1,000 miles through many seething, boiling rapids, from Green River, Wyo., to the mouth of the Virgin River. When Powell made his trips the Colorado was virtually unknown except for Indian legend and fabulous stories that had been told by the Spanish after they discovered the Colorado in 1540. Some of his men had carved their names into the walls at the "Music Temple," an enormous cave that was so named by Powell because of the tinkling reverberations that were set off when his men threw rocks into the pool of water inside.

There are signs that are much older. These are picture writings and stone houses that hang high in crevices on the canyon walls. The archeologists and anthropologists are studying the remaining evidences of the prehistoric people who inhabited this now barren region. They are discovering dwelling sites of the "Moki Indians" and already have collected samples of clothing and implements

A company of Mormon pioneers with 83 wagons crossed the Colorado River at this point on their way to settle in southeastern Utah near present community of Bluff, Utah. Twenty-six of the 83 wagons were driven down through the "Hole" and ferried across the river on the first day, January 26, 1880. The road and this crossing were used for one year as the main wagon route to southeastern Utah, and many wagons went both ways through the "Hole-in-the-Rock." This cleft in the canyon wall—the "Hole-in-the-Rock"—will not be flooded by the Glen Canyon Reservoir.

DR. STEPHEN DURRANT, mammalogist, displays a striped-whip snake he captured during the trip.

and remains of farm products that were a part of early man's existence.

But there are new signs too, where modern man has been working. They are the scars at the Glen Canyon Damsite where drill crews have left their mark, and in the huge holes near the bottom where the water of the Colorado River will be diverted from its channel so that a huge concrete dam can be constructed.

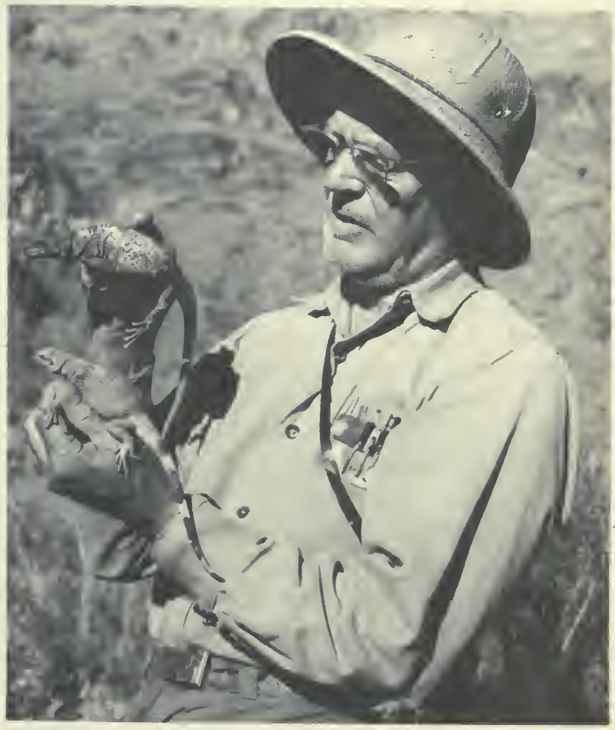
A large and beautiful lake will soon fill the area that we traveled on our ride down the river. The advent of clear, placid blue reservoir water into the Glen Canyon will present great recreational opportunities. Places now practically, if not completely, unknown and inaccessible will be reached by the smooth reservoir waters. And overland routes will be opened to the reservoir shore at many suitable locations.

The National Park Service is working on plans for recreational development of the 186-mile long reservoir. Some day—or rather some year—soon, citizens from all parts of the Nation will come to the Glen Canyon and its new reservoir to re-create themselves both spiritually and physically.

Our final landing at Lees Ferry was at muddy as our launching had been at Hite. But it went unnoticed. We were happy. We had spent a week viewing and exploring one of the multitude of canyon areas in the Colorado river basin. We had been privileged to delve a little into the past. We had seen the splendor of the Glen Canyon of the Colorado River, soon to be made available to all. It has whetted our appetite for further exploration of the deep and almost inaccessible canyons of the basin.

Regional Photographer Stan Rasmussen, who took all photos in this article, accompanied a group of University of Utah scientists making a biological reconnaissance of the Colorado River from Hite, Utah, to the Glen Canyon Damsite, 15 miles upstream from Lee Ferry, Ariz. This article presents his description of the boat trip and his reactions to this beautiful and placid 145-mile reach of the Colorado which was appropriately named "Glen Canyon" by Maj. John Wesley Powell in 1869.

DR. WOODBURY displaying two chuckwalla lizards he caught in the reservoir area behind Glen Canyon Dam site.



YOUR MAGAZINE

Are there particular types of articles which you would like to see in the Era that we have not printed to date? If so, please let us know, and we shall do our best to comply with your wishes.

75th Anniversary of Civil Service Act

Over 10,000 civil servants in the employ of the Bureau of Reclamation in the 17 Western States are joining other civil service workers in observance of the 75th Anniversary of the Civil Service Act recently proclaimed by President Dwight D. Eisenhower.

Many of these employees work closely with water users living on 134,000 Reclamation farms which encompass 7,600,000 acres constituting 77 Federal irrigation projects throughout the West. They cooperate with the water users in developing their farms and giving them technical aid which insures better crop returns and a better livelihood. They are also extensively engaged in the field of engineering building dams, canals, laterals, tunnels, etc., all a part of new Reclamation projects under construction.

All of the Bureau's top administrators, including the Commissioner, Assistant Commissioners, Regional Directors, and Division Chiefs, are career civil service employees.

The Bureau of Reclamation is primarily concerned with the development of land and water resources in the arid and semiarid areas.

President Eisenhower in proclaiming the 75th Anniversary of the Civil Service Act stated, in part, "* * * That the anniversary is an appropriate time to salute the Civil Service of the United States and to increase public knowledge and understanding of its importance in our system of self-government."

The Civil Service Act, signed into law on January 16, 1883, has stood for 75 years as the cornerstone of the American civil service system. It established the framework for a personnel system under which today over 2,000,000 employees work for the American people. In general, our earliest Presidents made appointments to public office on the basis of qualifications. But for approximately a half century prior to 1883, the slogan "To the victor belong the spoils" was the accepted principle in filling Government jobs. The spoils system reached such proportions that in 1841 when William Henry Harrison took office as President 30,000 to 40,000 office seekers swarmed into the capital city to claim the 23,700 jobs that made up the Federal executive service of that day.

The remedial climax to this situation came with the passage of the Civil Service Act which provided for the appointment of qualified workers to conduct the business of the Government in an orderly continuing manner. #

COOPERATION IN CANAL SAFETY

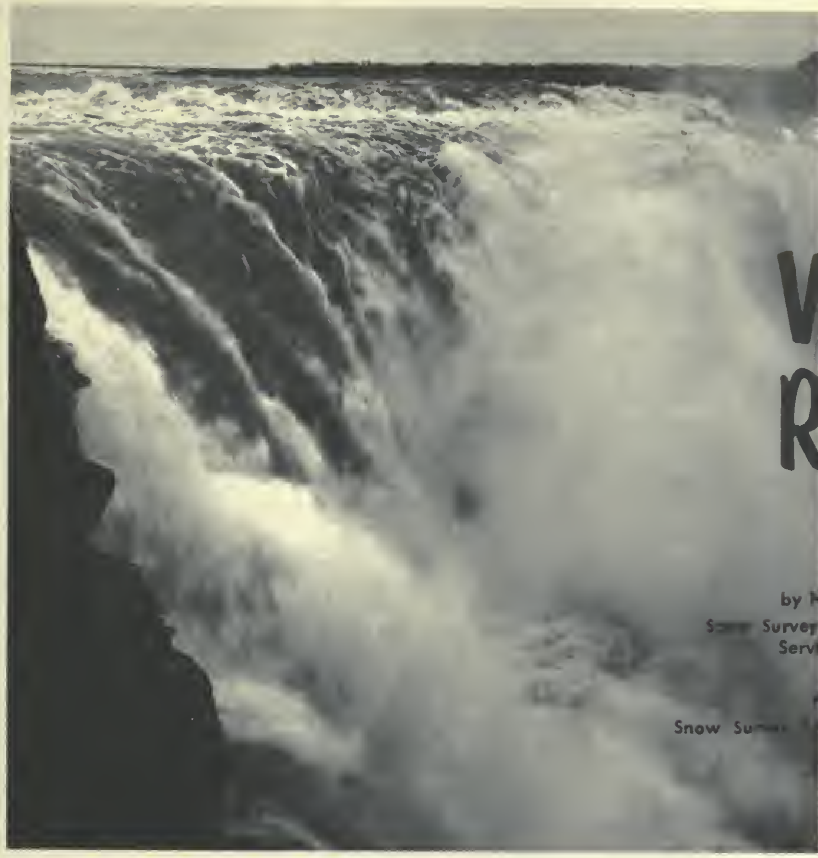
Assistant Secretary of the Interior Fred G. Aandahl recently announced that a cooperative safety campaign with the American National Red Cross has been launched to prevent drownings in canals and reservoirs on Western Reclamation projects. General Alfred M. Gruenther, president of the Red Cross, has pledged the full support of his great organization to Secretary Aandahl and Reclamation Commissioner W. A. Dexheimer in this program. It is intended to be an educational water safety campaign primarily directed toward conditions which now prevail in Western States where many reservoirs and canals have been constructed.

Mr. Richard L. Brown, Assistant Director, Safety Services, Water Safety Division of the National Red Cross and Mr. Ottis Peterson, Assistant to the Commissioner—Information, of the Bureau of Reclamation have been developing details for executing the program.

A pilot program will be undertaken during 1958 to be confined to Reclamation areas within the Bureau's Regional offices in Boise, Idaho, Sacramento, Calif., Boulder City, Nev., and Salt Lake City, Utah.

Messrs. William Blau and Ralph E. Carlson of the San Francisco Regional office of the Red Cross will work directly with Reclamation officials in these four Regions. The geographical sphere of this Red Cross Office is confined to the area west of the Continental Divide.

Continued on page 50



Water Report

by HOMER J. STOCKWELL
Snow Survey Supervisor, Soil Conservation Service, Fort Collins, Colo.
and
NORMAN S. HALL
Snow Survey Leader, Soil Conservation Service, Reno, Nev.

WATER SUPPLIES for almost all irrigated areas of western states ARE EXPECTED TO BE GOOD TO EXCELLENT IN 1958. Only in a few small areas of the western mountains is the snowpack less than normal for April 1. In a large area of California and the Southwest the snowpack approaches a maximum of record. Violent storms at the end of March and in early April resulted in a record increase in snowpack for such a short period. Forecasts range from 150 to 180 percent of normal of streamflows in the Central Valley. Elsewhere in Nevada, southern Utah, Arizona and southwestern Colorado, forecasts of seasonal streamflow of 125 to 150 percent of normal are typical.

On the Columbia Basin and in the northern Rocky Mountains snowfall during the winter has been near average. Unless there are extreme deviations from normal in precipitation or snowmelt during late spring there should be little concern for water shortage in this general area. In a few instances, reservoirs are being lowered as a precaution against the possibility of heavy storms with full assurance that water supplies will still be adequate.

Forecasts of 1958 irrigation water supplies and general water supply conditions in the West, prepared for RECLAMATION ERA, are based on April 1 measurements by the United States Department of Agriculture, Soil Conservation Service and many cooperating organizations[1] on about 1300 snow courses and 100 soil moisture stations, the latter both on the watershed and in irrigated areas. The amount of storage in nearly 250 reservoirs also is considered in appraising the water supply outlook.

Reviewing water supply conditions since the late spring of 1957, it is noted that precipitation has generally exceeded normal for the last 10 months. Streamflow from snowmelt in 1957 exceeded demands. This encouraged substantial reservoir storage holdover, thus adding to the 1958 water supply. Winter rainfall has left irrigated soils wet which will reduce the demands for early irrigation water.

The adequate water supply in sight for this season should not be allowed to result in careless use of water. As of now, the long-term water de-

[1] The Soil Conservation Service coordinates snow surveys conducted by its staff and many cooperators, including the Bureau of Reclamation, Forest Service, Geological Survey, other Federal Bureaus, various departments of the several states, irrigation districts, power companies, and others. The California State Department of Water Resources, which conducts snow surveys in that state, contributed the California figures appearing in this article. The Water Rights Branch, British Columbia Department of Lands and Forests has charge of the snow surveys in that province and likewise contributed the information here for British Columbia.

mands in many areas of the West exceed the supply. Demands are increasing. Every effort must be made to use this season's water supply as beneficially as if shortages were expected. Adequate water use for maximum production is desirable, but waste will erode the lands, aggravate drainage problems, deplete soil fertility and result in other long-term damages. Next winter's snowpack might be less plentiful. Carryover storage from this irrigation season in such case might well mean the difference between satisfactory water supplies or extensive shortages in 1959.

In the Pacific Northwest the water supply outlook is generally good. Some local shortage may occur in the Okanogan Valley of Washington. Snowpack is near normal. Soils in both irrigated and mountain areas are wet. Storage in irrigation reservoirs varies, being much above normal in Idaho and Oregon to slightly less than normal on the Columbia River tributaries in Washington. Storage in power reservoirs follows a similar pattern. Winter streamflow has been well above normal, especially on smaller tributary streams.

On the watershed of the Upper Missouri in Montana and Wyoming, snowpack is near normal. Soils under the snow are wet. Soil moisture conditions in irrigated areas are reported as good. Streamflow is expected to be near normal in 1958, except for the Wind River tributaries in Wyoming. Total water supplies are expected to be adequate except for late season shortages on small tributary streams.

The water supply outlook for irrigated areas of the North and South Platte rivers in Wyoming and Colorado is excellent. Streamflow from the mountain watershed probably will be near the average. Excess streamflow from the 1957 snowmelt season allowed for an unusually good carryover of water supplies in both government and privately operated reservoirs. Soil moisture conditions in irrigated areas are relatively good in contrast to recent years. A similar outlook prevails for the Arkansas River in Colorado and western Kansas.

For the first time since 1949, the water supply for the Rio Grande in Colorado, New Mexico and Texas is expected to be reasonably adequate. Streamflow will range near normal. Reservoir storage is well above average in Colorado and near average in New Mexico.

The water supply outlook for Arizona improved materially during March. Snowpack on the Salt and Gila watershed on April 1 was 300 percent of normal, and on the Verde 75 percent of normal. There will be an adequate water supply for irrigation with some carryover storage for next year.

Streamflow in Nevada and Utah will also be adequate to meet the needs. Irrigation water storage in both states is about 125 percent of normal. In some areas of the two states runoff will exceed demand, enhancing the prospects for holdover storage into 1959.

Snowpack in California is far above average, and will cause high flows from snowmelt. Soils in valley areas are wet. Storage in conservation reservoirs is 122 percent of normal.

Runoff forecasts for the major streams of the West for the April–September 1958 period as compared to normal include:

Columbia at The Dalles, Oregon.	92,000,000 ac. ft. or 96 percent
Missouri River at Fort Benton, Montana.	3,258,000 ac. ft. or 96 percent
Colorado River at Grand Canyon, Arizona.	11,300,000 ac. ft. or 112 percent
Sacramento River inflow to Shasta Reservoir, California.	3,650,000 ac. ft. or 150 percent
San Joaquin below Friant Reservoir, California.	2,270,000 ac. ft. or 163 percent

This analysis is again presented in the *Reclamation Era* through the courtesy of the authors, and *Mr. R. A. WORK, Head, Water Supply Forecasting Section.* In the following paragraphs the water supply outlook by states is briefly reviewed.

ARIZONA The snowpack as of April 1 is about 300 percent of normal in the Salt and Gila river watersheds and 75 percent in the Verde River watershed. Runoff during January through March has been above average, and with runoff for April through May forecast from average to much above, total January through May runoff will be about 200 percent of average for the Upper Gila, 130 percent for the Salt River, and 120 percent for the Verde River.

Heavy February and March precipitation changed the water supply outlook in Arizona from poor to the best since 1952. There will be adequate water for the normal irrigation and some carryover storage for next year. Groundwater overdraft will not be relieved, however.

CALIFORNIA The California Department of Water Resources reports that the water supply outlook for the coming season is markedly above normal for the entire state. Runoff during the snowmelt period should be among the highest on record.

This outlook comes as a result of one of the wettest winters in recent years. Precipitation over the entire state since last July averages almost 160 percent of normal. Record-breaking storms occurred in February, March, and early April. Runoff during the first six months of the water year has been about 190 percent of average. In fact, runoff in most of the streams in southern California is above normal for the first time in several years. Late March and early April storms brought substantial increase to the state's snowpack and it is estimated that snow-stored water is about 140 percent of normal.

Water stored in surface reservoirs on April 1 was about 120 percent of average.

Consequently, runoff during the remainder of the 1957–58 water year on major snow-fed streams is expected to average about 160 percent of normal.

COLORADO Water supplies will be adequate for most of the irrigated areas in Colorado this season. Snowfall has been average or above in the mountains except for two small areas on South Platte tributaries north of Denver. Well above normal snowfall has been measured in southwest Colorado. Soils under the snow are wetter than usual in the southern half of the state, but about average in the north.

Contributing to the favorable water supply outlook is the large carryover storage in irrigation reservoirs from the heavy streamflow year of 1957. Excluding the larger conservation and flood control reservoirs, storage is now 70 percent of capacity as compared to only 21 percent a year ago. In contrast to recent drouth years, soil moisture conditions in irrigated areas are good.

The excess snowfall on the San Juan Mountains in southwestern Colorado gives cause for concern lest damage from high streamflow occurs. Snowpack is approaching the recorded maximum measured on May 1 and June 1, 1957. Since mountain soils are wet, very little snow water will be required to prime these soils. Flows equal to or exceeding the high flows of 1957 are definitely possible.

IDAHO The water supply outlook for northern Idaho is for normal streamflow during 1958. In the southern half of the state, the snowpack is well above normal and forecasts of good streamflow are general.

The Blackfoot and Portneuf rivers in eastern Idaho still have a heavy snowpack, but melt conditions have been favorable for reducing the snowmelt flood potential. The snow on the south slopes of these drainages has been melted at the lower elevations and significantly reduced at high altitudes. Heavy rains on these rivers would produce extremely high water, but the chances of a maximum snowmelt coinciding with rainfall are rather small.

Reservoirs in Idaho are above normal, and the new Palisades Reservoir on the Snake River will fill for the first time in 1958. This reservoir alone adds more than one million acre feet of stored water that has not been available in the past.

The Upper Columbia and Kootenai rivers are forecast to flow a little below normal for 1958. The water supply for these rivers is adequate, but they do not pose the high water potential which has occurred several times in the recent years.

KANSAS Moisture conditions are good along the Arkansas River in western Kansas. Precipitation, mostly in the form of snow, has been well above normal during the winter. High storage in John Martin Reservoir in Colorado, along with good prospective inflow, assures an adequate water supply for this season.

MONTANA Water supply outlook along the major streams in Montana is good for 1958. Streamflow east of the Continental Divide is expected to be about 90 percent of average and equal to a year ago. In the Columbia Basin streamflow will be a little above normal and slightly more than in 1957. Streamflow during the winter has been below average in the mountains and extremely deficient in prairie streams. Reservoir storage is near average. Soils in irrigated areas are wetter than in recent years.

NEBRASKA Water supplies along the Platte River in western Nebraska will be adequate this year. Storage in the major reservoirs on the North Platte in Wyoming now totals about 1,625,000 acre feet, or almost twice normal. Of this amount, about 900,000 acre feet are available for use on the older North Platte Project in eastern Wyoming and western Nebraska. In addition, inflow to Seminoe Reservoir is expected to be about 120 percent of normal. Soil moisture conditions in the irrigated areas are good in contrast to recent years. Storage in Kingsley Reservoir is about 1,000,000 acre feet and near normal. This storage is adequate for needs of the tri-county area.

NEVADA This will be the best irrigation water year since 1952. Forecasts on the Owyhee River in northern Elko County are for about 177 percent of normal, 132 percent on the main Humboldt at Palisade, 125 percent on the Walker watershed, and 148 percent on the Carson River system.

Early April storms have increased the mountain snowpack, especially in the Sierras. Water content of the snow courses are below those measured in the record-breaking year of 1952. Most reservoirs are being lowered in anticipation of the high expected flows.

The Truckee Basin Water Committee reports that all of its reservoirs will be filled to capacity. On April 1, the elevation of Lake Tahoe was at 6228.25 feet, storing 630,000 acre feet. Controlled releases are being made to keep the lake below the legal maximum.

April 1 storage in seven important reservoirs was 78 percent of capacity or 120 percent of the 15-year 1938–52 normal. During March, Rye Patch Reservoir storage increased about 19,000 acre feet. It now stores 100,000 acre feet, normal for this time of year.

NEW MEXICO The water supply outlook for New Mexico is the best in about 10 years. The flow of the Rio Grande through New Mexico is expected to be near normal for the first time since 1952. Snowpack in northern New Mexico, although not excessive, is 140 percent of normal. Mountain soils are wet. Storage in Elephant Butte Reservoir is about 85 percent of normal as compared to 10 percent of normal a year ago. Water supply for the Tucumcari and Carlsbad projects is also favorable with relatively high reservoir storage. There is good soil moisture in irrigated areas, and at least average runoff is expected from snowmelt.

OKLAHOMA The water supply outlook for this season for the Altus Project in Oklahoma is good. Winter precipitation has been above normal. Storage in the W. C. Austin Reservoir is adequate for this year's demands providing there is average precipitation during the summer.

OREGON Oregon will have average to abundant water supplies for irrigation this year. Even though the winter has been unusually warm the mountain snowpack is 114 percent of average and 85 percent of a year ago. The streamflow forecasts vary from a low of 90 percent of average on the Clackamas River to a high of 164 percent on the Owyhee River. Watershed soils under the snowpack are well wetted throughout the state—a factor which will favor an adequate runoff from snowmelt. However, lack of low elevation snow may cause late season shortages on streams with low elevation watersheds.

Reservoired water supplies are 129 percent of average and 81 percent of capacity in 23 important reservoirs.

TEXAS With near average storage in Elephant Butte Reservoir in New Mexico and a normal snowmelt inflow in prospect, the water supply outlook for the irrigated area along the Rio Grande in west Texas is the best for several years. Soil moisture conditions in irrigated areas are relatively good. In contrast, the Pecos area has poor prospects at this time. Soil moisture conditions there are good, but the storage in Red Bluff Reservoir is extremely inadequate.

UTAH Water supply outlook for Utah is the best for several years. Storms during March increased the snowpack from 100 to 1000 percent of the normal increment for the month. All streams in the state are now forecast at above normal flows except for the eastern part of the Uinta Basin where the range is 90 percent to 100 percent of normal. For the state as a whole, the snow cover is 117 percent of normal for April 1. The effects of March storms extended over into the Colorado River drainage and resulted in substantial improvements in the water supply outlook in Colorado River tributaries. Forecasts on the Price and San Rafael basins are now from 125 to 150 percent of average. The Sevier River Basin, which has had deficient water supplies for several years will

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ZINC DEFICIENCY

Continued from page 38

Three rows of beans on right were sprayed with zinc sulphate 21 days before photo was taken.

after the symptoms appear will not correct the condition, but it can be corrected by applying zinc to the soil before the potatoes are planted. On the other hand, the White Rose variety of potatoes, also extensively grown, will not show zinc deficiency.

Why is zinc deficiency spreading? For one thing we may be becoming more aware of it because we know better what symptoms to look for. On the other hand, there have been many changes in soil management which may be conducive to cropping the available zinc from our soils. Crop yields are higher and, hence, more zinc is removed. We use less barnyard manure. We use more nitrogen fertilizers in growing crops and there is considerable evidence to indicate that high-nitrogen programs induce the luxury consumption of available zinc by plants.

As mentioned, land leveling often induces zinc deficiency. However, we should not let this stand in our way of developing efficient irrigation systems. Rather, we should correct zinc deficiency.

In a short article it is impossible to discuss in detail all of the symptoms of zinc deficiency or methods of correcting it. However, if you have stunted plants with greatly shortened internodes, chlorosis of the leaves or very small leaves, be suspicious of zinc deficiency and consult your county extension agent or other reputable specialist.

# # #

CANAL SAFETY

Continued from page 46

It is proposed to confine the safety program on a concentrated effort to keep people out of canals and ditches rather than teaching them to swim. The latter, of course, is desirable in any safety program. Efforts to impress upon the parents of young children the necessity of constant watchfulness in canal areas will also be a feature of the program.

The tentative plan is to concentrate on the following areas this year:

Salt River project in Arizona—to be handled by the Maricopa County Chapter of the Red Cross

Friant Dam and associated canal projects—to be handled by the Fresno County Chapter

Folsom Dam area— to be handled by the Sacramento Chapter

Contra Costa Canal area—to be handled by an as yet undesignated Red Cross Chapter

Klamath project—to be handled by an as yet undesignated Red Cross Chapter

Ogden River project area—to be handled by the Salt Lake County Chapter

Yakima project area—to be handled by an as yet undesignated Red Cross Chapter

Boise, Idaho, area—to be handled by an as yet undesignated Red Cross Chapter

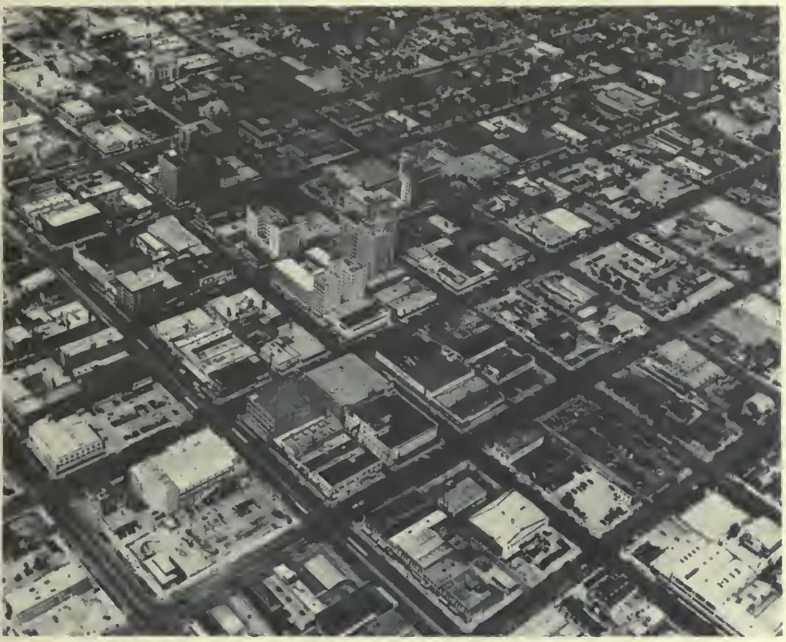
A similar safety public educational program has been launched in cooperation with the Governors of the 17 Western States, the Bureau of Reclamation, law enforcement agencies, school groups, and civic organizations. All have assured us of their cooperation and interest. #

Fifty-five Farm Units To Be Sold During the Year

Twelve full-time farm units on the Eden project in Wyoming will be available for purchase, approximately June 1, from the Soil Conservation Service at Rock Springs, Wyo., Reclamation Commissioner Dexheimer recently announced. These units will embrace 2,735 acres of land.

On the Wellton-Mohawk Division of the Gila project in Arizona, 33 farm units will be available for purchase from the Bureau of Reclamation about November 1. These units embrace 7,050 acres of land.

In the case of the Gila project, veterans will have the preference to purchase.



PHOENIX, ARIZ. *Army Air Corps photo.*

FRONTIER WITH A FUTURE

PART TWO

This is the concluding part of this article on the Power System Dispatching Organization of the Parker-Davis Power System.

The Central Dispatching Office of this System is located in Phoenix, Ariz., where you can walk down any busy street and point to every other person you see and say, statistically speaking, he wasn't here 10 years ago—yes, the population of Phoenix has approximately doubled since 1947. According to the City Manager's Office, people have been moving to the Phoenix area at the rate of approximately 25,000 per year.

Phoenix is both the political and economic capital of the Grand Canyon State, as well as being its largest city. It is also the county seat of Maricopa County, and the hub of the "Valley of the Sun."

Factors in the booming economy include a lucrative winter tourist business, agriculture, and industry.

What is the reason for this rapid expansion? Well, the climate is fabulous, and the growth of industry is providing the jobs needed to enable people to settle down in Phoenix, rather than just limit their presence to vacation periods.

Through the use of irrigation during the past many years, this Valley of the Sun, which is basically composed of arid lands, has been turned into an area of rich farms and attractive communities. In fact, irrigation has always been a prerequisite to intensive crop production in the Valley. Archaeological evidence indicates that farming by irrigation, as now practiced, is a modern revival of an ancient agricultural development in the Gila and Salt River Valleys, where present canals are found to closely follow the route of an ancient canal system.

Partly due to the availability of low-cost power produced at Hoover, Davis, and Parker Powerplants, irrigation and industrial development in the area has been greatly expanded since World War II. These accomplishments, however impressive at the moment, will be quite insignificant when compared to the accomplishments that will take place in the next 10 years.

In shouldering its share of the Power System's responsibilities in the area, the Parker-Davis project, which generates and transmits electric power to the various distributors throughout the area, has equipped its System Dispatchers with the most modern devices in use in the industry today. One of the more important of these devices is telemetering (tele-distance—distance metering).

Keeping track of 19 interconnections with associated power-factor problems and nearly 2,000

by WILLIAM M. DOAK, Chief, Systems Operation Division, Parker-Davis Project Office, Phoenix, Ariz.

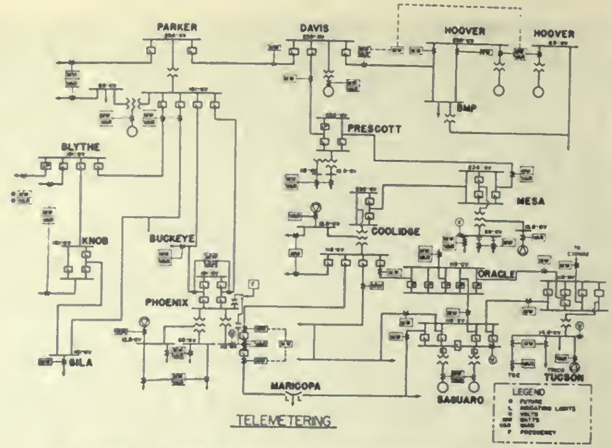
miles of high-voltage transmission circuits would become a chronic headache to the Parker-Davis System Dispatchers if it were not for the modern telemetering and automatic breaker-position indications which are provided in the System's Central Dispatching Office in Phoenix, Ariz.

Telemetering has experienced a steady development for approximately 40 years. In its beginning, it consisted simply of measuring an electrical quantity at one point and transmitting it over metallic circuits to a remote point for indication. It saved many steps and telephone calls by placing continuous indications of magnitude of current, voltage, and power in front of the power station operating engineer. From this simple beginning, it has expanded to encompass entire power systems and interconnections to adjoining power systems. The data that are gathered in this manner are so accurate, and the methods that are used to totalize that information are so reliable, that the telemetering equipment and the associated automatic load control apparatus are now performing many functions that directly aid the Power System Dispatcher. The value of the telemetering system and the automatic load-control apparatus installed on the Parker-Davis System has been amply demonstrated many times.

Although we, who are engaged in electric utility system operations, are inclined to think of telemetering in connection with centralized dispatching systems only, we find the principles of telemetering present in our every day life. As an example—we use localized remote metering systems every time we drive our car. The oil pressure gage, temperature gage, and fuel indicator are examples of a remote reading of quantitative metering. In modern cars, these meet the essential requirements of telemetering in that they have a telemetering unit, a channel of some type, and a read-out device.

Waterworks' systems use telemetering to bring in information concerning flow rate, pressure, and other values. The military also use telemetering to bring back information concerning missile flights and performance of manned aircraft.

Complete surveillance of the Parker-Davis Power System is provided for its System Dispatchers through the eyes of 62 telemetering instruments installed in the System's Central Dispatching Office in Phoenix, Ariz. Available are: instantaneous recordings of systemwide power flows; power interchange with principal



PRESENT and PLANNED telemetering received at Phoenix.

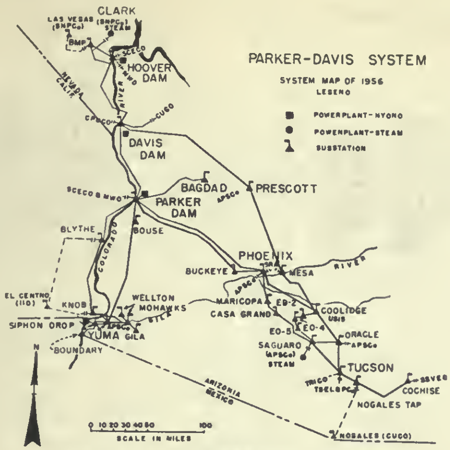
interconnected systems; kilowatt and kilovar loadings on generating plants; loadings on major transmission circuits and synchronous condensers; system voltage and frequency; oil circuit breaker positions on major transmission circuits; and other information essential to good dispatching practice.

Telemetering information is conveyed via carrier current over the System's 230-, 161-, and 115-kv. transmission lines, with all quantities recorded at both transmitting and receiving terminals.

The telemeter channels are both tone modulated and frequency-shift carrier. The frequency-shift carrier-current apparatus uses quartz crystals to control transmitter frequencies.

Each transmitter and each receiver is an independent unit, complete with its own 115-volt, 60-cycle, single-phase power supply.

Aside from measuring routine quantities efficiently, the telemetering system is a strong trouble shooter. Not long ago one of the major 230-kv. transmission circuits became permanently disabled during a severe summer storm. With this important circuit out of service, the System Dispatcher was immediately confronted with the necessity of drastically curtailing service to the numerous customers affected. However, with the invaluable aid of the telemeters available, he was able to carefully load all other circuits, fully and minute-to-minute, up to the established emergency-loading limits. Under conditions such as this, system voltages are increased at different points on the system in order to permit it to transmit additional power, and, at the same time, not exceed stability limits. This function was accu-



Area served by Parker-Davis system.

rately controlled by the System Dispatcher through the effective use of the telemetering facilities provided. Thus, in this particular instance, the net benefits derived were:

(1) A very minimum of load had to be dropped.

(2) The remaining system was enabled to carry much more load, and still maintain good service.

(3) All utility distribution systems served by the Parker-Davis Transmission System were enabled to serve all of their cities and towns.

(4) The public interests, in general, were very much better taken care of than would have been possible without the availability of telemetering facilities.

From the standpoint of system operations, without the application of telemetering equipment in instances such as this, conventional communication channels would have quickly become overburdened and bogged down, and it would have also required considerable time for the System Dispatcher to call the different substations and powerplants to determine plant loading, line loading, and voltage values on the many sections of the system involved. As a matter of fact, during periods of normal operations, the regular communication system is relieved to a great extent of the need for routine calls to the Central Dispatching Office, and is available for other traffic.

Indications of opening and closing of certain pertinent oil circuit breakers are transmitted automatically to the Central Dispatching Office. These breaker indications are superimposed upon supervisory control channels at various substations and powerplants. Each breaker operation will light a lamp on the System Dispatchers' diagram board, as well as sounding a short alarm. Since the board is normally dark, dispatching personnel can easily distinguish where the breaker position change has occurred. The execution of prearranged breaker changes can be observed in the same manner.

Time and space will not permit a more detailed explanation of this important function.

One of the most essential responsibilities of the supervisors and foremen on the Parker-Davis Project is to train each employee in his Division, Branch, or Section to become fully aware of his personal responsibility to assist the System Dispatchers, as representatives of management, in attaining an enviable record in regard to:

(1) reliability of service

(2) quality of service

(3) economy of production

(4) maximum safety to personnel and equipment

Although reliability is placed ahead of the others, one depends upon the other, and the System Dispatchers consider them all collectively. # # #

This Is the Bees' Knees!

To prevent orchard pollinating bees from spreading fireblight to apple and pear blossoms, plant pathologists have come up with the novel idea of making the bees carry the cure instead of the disease. They powder them with a fire-blight-killing antibiotic, streptomycin, by means of a simple wooden trap inserted at the beehive entrance. The bees can't get in or out without walking through the streptomycin, which clings to their bodies ready to kill or inactivate any fireblight-producing bacteria they might pick up as they gather nectar. In controlled greenhouse tests, fireblight infection of pear blossoms has been reduced from about 40 to less than 1 percent. The method is to be tested this year in field orchards.

Wilt Is Less in Thick Cotton Fields

New Mexico A. & M. College reports that when upland cotton is planted on land infested with Verticillium wilt, closer spacing of plants in the row will result in less wilt damage and higher yields per acre. Stands averaging four plants per foot a row had 15 percent fewer wilt-infested plants and up to 70 percent more cotton per acre. Thick spacing also increases the efficiency of mechanical cotton pickers.

WATER REPORT

Continued from page 49

have above normal runoff this year. The flow of the Virgin River will be slightly above normal. Streamflow in northern Utah is expected to be about average.

Storage in 15 principal reservoirs is now 3,759,000 acre feet, which is 61 percent of capacity and 124 percent of average.

WASHINGTON Water supplies for the areas of Washington east of the Cascade Range are expected to be generally adequate. Possibility of water shortage is not likely in the central areas of Washington, but limited flows can be expected on the Okanogan. Forecasts of streamflow range from 86 to 104 percent of normal. In the state as a whole the snowpack has below normal amounts of water for this time of year. Irrigation reservoir storage is generally below average as of April 1, although there are above normal amounts of water in storage in Conconully and Salmon lakes. Power reservoirs also have less water in storage than the average for this time of year.

WYOMING Prospective streamflow from the high mountain watersheds varies from 60 percent of normal on the Popo Agie tributary of the Wind River to 120 percent of average on the North Platte at Seminoe Reservoir. Flow of the Green River in the Colorado River Basin will be near normal and adequate for all needs this year. The outlook is similar for the Snake River and its tributaries in western Wyoming. Storage in the Seminoe, Pathfinder, Alcova, and Guernsey reservoirs on the North Platte totals about 1,625,000 acre feet, twice normal for this date. Soil moisture in irrigated areas of eastern Wyoming is good. With more than 1,000,000 acre feet inflow expected in these reservoirs during the April–September period, good water supplies for the year are assured. The outlook is favorable for two or three years even if future snowfall is deficient. More than 75,000 acre feet is in storage in the Wheatland Reservoir, and above normal flow is forecast for Laramie River. The water supply outlook for the Wheatland district is the best of recent years except for last year. # # #

Water Stored in Western Reservoirs

(Operated by Bureau of Reclamation or Water Users except as noted)

Location	Project	Reservoir	Active Storage (in acre-feet)		
			Active capacity	Mar. 31, 1957	Mar. 31, 1958
Region 1	Baker	Thief Valley	17,400	17,400	17,800
	Bitter Root	Lake Como	34,800	11,800	8,300
	Boise	Anderson Ranch	423,200	208,300	165,700
		Arrowrock	286,600	276,300	123,700
		Cascade	654,100	358,800	291,400
		Deadwood	161,900	73,500	50,400
		Lake Lowell	169,000	143,100	152,100
		Lucky Peak	278,200	186,100	194,900
	Burnt River	Unity	25,200	22,000	12,300
	Columbia Basin	F. D. Roosevelt Lake	5,072,000	2,102,000	2,034,000
		Grand Coulee Equalizing	761,800	528,900	751,100
		Potholes	470,000	307,500	231,800
	Deschutes	Crane Prairie	55,300	55,000	55,000
		Wickiup	187,300	[1] 200,000	195,000
	Hungry Horse	Hungry Horse	2,982,000	1,364,400	1,669,100
	Minidoka	American Falls	1,700,000	1,672,000	1,691,600
		Grassy Lake	15,200	13,900	12,900
		Island Park	127,200	122,900	127,400
		Jackson Lake	847,000	149,400	490,400
		Lake Walcott	95,200	[1] 102,400	80,600
	Ochoco	Ochoco	47,500	44,700	38,300
	Okanogan	Conconully	13,000	9,800	8,300
		Salmon Lake	10,500	9,500	9,700
	Owyhee	Owyhee	715,000	696,700	637,500
	Palisades	Palisades	1,202,000	307,900	758,600
	Umatilla	Cold Springs	50,000	45,200	50,000
		McKay	73,800	52,400	66,100
	Vale	Agency Valley	60,000	58,700	57,200
		Warm Springs	191,000	[1] 192,800	180,000
	Yakima	Bumping Lake	33,700	27,100	27,200
		Clear Creek	5,300	5,300	5,300
		Cle Elum	436,900	367,000	170,600
		Kachess	239,000	206,700	139,900
		Keechelus	157,800	131,600	87,200
		Tieton	198,000	160,400	114,600
Region 2	Cachuma	Cachuma	201,800	37,800	107,200
	Central Valley	Folsom [2]	920,300	556,600	[2] 569,900
		Jenkinson Lake	40,600	[1] 40,800	41,200
		Keswick	20,000	17,300	18,300
		Lake Natoma	2,800	900	1,900
		Millerton Lake	427,800	238,400	386,200
		Shasta Lake	3,998,000	3,561,900	3,740,200
	Klamath	Clear Lake	513,300	396,000	414,100
		Gerber	94,300	87,300	86,700
		Upper Klamath Lake	524,800	465,200	471,400
	Orland	East Park	50,600	49,900	49,200
		Stony Gorge	50,000	[1] 50,800	45,700
Region 3	Boulder Canyon	Lake Mead	27,207,000	11,502,000	19,092,000
	Parker-Davis	Havasu Lake	216,500	166,700	72,200
		Lake Mohave	1,809,800	1,689,700	1,737,900
	Salt River	Apache Lake	245,100	162,000	239,000
		Bartlett	179,500	123,000	145,000
		Canyon Lake	57,900	50,000	54,000
		Horseshoe	142,800	68,000	106,000
		Roosevelt	1,381,600	159,000	264,000
		Sahuaro Lake	69,800	63,000	64,000

[1] Includes some super storage above active capacity.
[2] Corps of Engineers Reservoir.

Water Stored in Western Reservoirs—Continued

Location	Project	Reservoir	Active Storage (in acre-feet)		
			Active capacity	Mar. 31, 1957	Mar. 31, 1958
Region 4	Eden	Big Sandy	38,300	11,100	(3)
	Fruitgrowers Dam	Fruitgrowers	4,500	1,800	4,500
	Humboldt	Rye Patch	190,000	63,100	100,300
	Hyrum	Hyrum	15,300	12,000	12,200
	Mancos	Jackson Gulch	9,800	900	7,800
	Moon Lake	Midview	5,800	4,800	5,400
		Moon Lake	35,800	9,300	(3)
	Newlands	Lahontan	290,900	251,900	234,000
		Lake Tahoe	732,000	597,600	625,200
	Newton	Newton	5,400	2,500	3,800
	Ogden River	Pineview	110,200	15,400	4,700
	Pine River	Vallecito	126,300	22,600	66,200
	Provo River	Deer Creek	149,700	82,700	95,800
	Scofield	Scofield	65,800	6,000	41,500
	Strawberry Valley	Strawberry	270,000	141,800	159,800
	Truckee Storage	Boca	40,900	22,100	9,000
	Uncompahgre	Taylor Park	106,200	25,300	83,100
	Weber River	Echo	73,900	36,700	43,500
Region 5	W. C. Austin	Altus	162,000	8,900	92,200
	Balmorhea	Lower Parks	6,500	5,800	6,200
	Carlsbad	Alamogordo	122,100	4,600	100,000
		Avalon	6,000	2,500	1,600
		McMillan	32,300	17,400	25,600
	Colorado River	Marshall Ford	1,837,100	603,400	840,300
	Middle Rio Grande	El Vado	194,500	800	38,200
	Rio Grande	Caballo	340,900	4,200	123,000
		Elephant Butte	2,185,400	63,500	705,000
	San Luis Valley	Platoro	60,000	1,000	30,400
	Tucumcari	Conchas [2]	467,300	55,400	153,600
	Vermejo	Reservoir No. 2	2,900	0	1,800
		Reservoir No. 13	5,000	1,600	3,200
		Stubblefield	16,100	0	8,300
Region 6	Missouri River Basin	Angostura	92,000	33,500	58,100
		Boysen	710,000	192,600	212,600
		Canyon Ferry	1,615,000	1,012,400	1,169,900
		Dickinson	13,500	3,900	6,100
		Fort Randall [2]	4,900,000	1,752,200	2,289,600
		Garrison [2]	18,100,000	1,002,800	4,565,000
		Heart Butte	218,700	46,900	72,100
		Jamestown	39,200	4,900	13,000
		Keyhole	190,300	2,600	2,800
		Lewis & Clark Lake [2]	385,000	278,600	288,700
		Pactola	55,000	1,200	14,600
		Shadehill	300,000	76,400	80,900
		Tiber	762,000	57,100	87,300
	Belle Fourche	Belle Fourche	185,200	49,900	78,200
	Fort Peck	Fort Peck [2]	14,839,000	1,743,700	3,399,700
	Milk River	Fresno	127,200	110,200	63,500
		Nelson	66,800	49,400	47,900
		Sherburne Lake	66,100	21,100	23,700
	Rapid Valley	Deerfield	15,100	8,600	11,600
	Riverton	Bull Lake	152,000	63,200	60,600
		Pilot Butte	31,600	21,800	20,700
	Shoshone	Buffalo Bill	380,300	116,400	130,000
	Sun River	Gibson	105,000	41,900	31,200
		Pishkun	30,100	16,200	12,100
		Willow Creek	32,400	24,000	20,600
Region 7	Colorado-Big Thompson	Carter Lake	108,900	71,900	100,500
		Granby	465,600	37,800	286,300
		Green Mountain	146,900	50,200	70,900
		Horsetooth	141,800	91,400	116,200
		Shadow Mountain	1,800	1,500	1,200
		Willow Creek	9,100	2,000	3,000
	Missouri River Basin	Bonny	167,200	38,400	43,100
		Cedar Bluff	363,200	68,700	185,400
		Enders	66,000	34,100	36,000
		Harlan County [2]	752,800	66,100	274,000
		Harry Strunk Lake	85,600	27,700	33,600
		Kirwin	304,800	1,600	81,500
		Swanson Lake	249,800	88,400	116,300
		Webster	257,400	0	54,600
	Kendrick	Alcova	24,500	11,500	27,900
		Seminoe	957,000	240,100	561,400
	Mirage Flats	Box Butte	30,400	16,700	25,700
	North Platte	Guernsey	39,800	900	30,000
		Lake Alice	11,200	10,900	1,900
		Lake Minatare	59,200	18,600	31,800
		Pathfinder	1,010,900	313,100	797,000
Alaska District	Eklutna	Eklutna Lake	160,000	81,400	94,900

[2] Corps of Engineers Reservoir.
[3] Not reported.

LAND RECLAMATION

A CENTURY AGO landowners of the Atlantic Coast States were making serious objection to development of the Ohio and Mississippi Valleys under the homestead law. They feared that the competition of new lands would create a surplus of agricultural products and thus force prices down and ruin their market. In subsequent years every reclamation project in the West aroused the same fears and protests. It is easy today to criticize the lack of vision displayed by these early opponents of immigration, and yet the same cry, in slightly modified form, is now being raised in connection with reclamation projects in the West.

Because agriculture is faced with a serious problem of overproduction, there is a general belief that the reclamation program should be halted until consumption catches up with agricultural output. Such a view is a hasty conclusion that is in no way based on the facts.

While it is true that the United States is producing more wheat, corn, and cotton than it can sell at a profit and that the planting of additional acres in these staples would be unwise, it does not necessarily follow that there is a surplus of arable land. Each year the United States imports enough food to put many thousands of acres to work, and with proper irrigation waste lands proposed for reclamation would be suitable for raising these crops.

America's land problem is not that there are too many acres under cultivation but that too many acres are planted in the same crops and too much poor land is producing poor crops when there are unclaimed acres which, through irrigation, could be made to produce better crops at less cost.

—LEBANON (PA.) NEWS.

[Reprinted from the New Reclamation Era, September 1931.]

MAJOR RECENT CONTRACT AWARDS

Spec. No.	Project	Award Date	Description of Work or Material	Contractor's Name and Address	Contract Amount
DS-4973	Missouri River Basin, Wyo.	Jan. 16	Six 7,750/9,687-kva power transformers for Fremont Canyon powerplant.	Crompton Parkinson, Ltd., Hayes, Middlesex, England.	$206,403
DC-4986	Solano, Calif.	Jan. 2	Construction of earthwork, concrete canal lining, and structures for Putah South canal, Green Valley conduit and subconduit; and two earth dams.	Darkenwald Construction Co., Inc. and Vinson Construction Co., Sacramento, Calif.	1,537,474
DC-4988	Washita Basin, Okla.	Feb. 3	Construction of Fort Cobb Dam	Hyde Construction Co. and Cook Construction Co., Jackson, Miss.	3,318,432
DC-4993	Missouri River Basin, S. Dak.	Jan. 6	Stringing conductors and overhead ground wires for 67 miles of Utica Junction-Sioux Falls 230-kv transmission line; and installing 230-kv air-break switches for Utica Junction tap switching station.	Hallett Construction Co., Crosby, Minn.	754,780
DS-4995	Missouri River Basin, N. Dak.	Feb. 10	Three 20,000/26,667/33,333-kva autotransformers for Fargo substation.	Legnano Electric Corp., New York, N. Y.	330,820
DC-4999	Missouri River Basin, Kans.	Feb. 20	Construction of earthwork and structures for Osborne canal	Bushman Construction Co., St. Joseph, Mo.	324,750
DC-5000	Columbia Basin, Wash.	Jan. 8	Construction of earthwork, concrete canal lining, and structures for Esquatzel diversion canal.	Donald M. Drake Co., Portland, Oreg.	2,681,004
DC-5002	Missouri River Basin, Colo.	Feb. 10	Reconductoring 53 miles of Greeley-Fort Morgan section of the Greeley-Beaver Creek 115-kv transmission line.	Crawford Electric Co., North Platte, Nebr.	239,887
DC-5004	Central Valley, Calif.	Mar. 11	Construction of earthwork, pipe lines, and structures, including pumping plants, for laterals 119.6 and 122.5 and sublaterals, Unit 1 extensions, Southern San Joaquin Municipal Utility District, Friant-Kern canal distribution system.	Cen-Vi-Ro Pipe Corp., South Gate, Calif.	698,165
DS-5006	Missouri River, Basin Wyo.	Mar. 19	Two 144-inch butterfly valves for Fremont Canyon powerplant (of Government design), Schedule 1.	Yuba Consolidated Industries, Inc., Yuba Mfg. Division, Benicia, Calif.	231,950
300C-102	Colorado River Front Work and Levee System, Ariz.-Calif.-Nev.	Jan. 27	Stockpiling rock material for river bank protection	Sierra Construction Co., Merced, Calif.	146,270
400S-97	Colorado River Storage, Ariz.-Utah.	Feb. 19	Furnishing electric service in Government areas for Page, Ariz	Arizona Public Service Co., Phoenix, Ariz.	213,389 (total annual estimated cost)
701C-456	Missouri River Basin, Nebr.-Kans.	Jan. 3	Construction of turnouts and wasteway structures, drains and relocation of lateral.	Bushman Construction Co., St. Joseph, Mo.	139,195
700C-459	Missouri River Basin, Nebr.-Kans.	Feb. 10	Construction of earthwork and structures for Franklin floodway drains and lateral extensions.	Bushman Construction Co., St. Joseph, Mo.	189,991

Construction and Materials for Which Bids Will Be Requested Through June 1958*

Project	Description of work or material
Central Valley, Calif.	Replacing 5 wood bridges with 5 bridges of treated timber. On the Contra Costa Canal, near Antioch.
Do	One 84-inch jet flow gate for the Trinity Dam auxiliary outlet works gate chamber. Estimated weight: 80,000 pounds.
Collbran, Colo	Clearing the Vega Reservoir area, about 10 miles east of Collbran.
Columbia Basin, Wash.	Earthwork and structures for about 19 miles of open ditch drains and wasteways, extending a drain about 2 miles and deepening about 2,200 feet of drain. Southeast of Moses Lake; southwest and northwest of Othello and southeast of Quincy.
Do	Constructing about 7,600 feet of tile underdrain, Weber Wasteway, and about 7,600 feet of open outlet drain. East of Moses Lake.
Do	Installing about 350 feet of 12-inch buried concrete cylinder pipe at Soap Lake.
Do	Constructing shop, residences, and service building for Wahluke Watermaster Headquarters, south of Othello.
Crooked River, Oreg.	Constructing the 186-foot-high earth and rockfill Prineville Dam, containing about 1,350,000 cubic yards of material and having a crest length of 780 feet, and appurtenant structures. On the Crooked River, about 21 miles southeast of Prineville.
Gila, Ariz	Constructing one 40- by 60-foot office building of block-type construction and furnishing and erecting one 40- by 60-foot prefabricated steel shop building. At Yuma.
Little Wood River, Idaho.	Clearing about 73 acres in the Little Wood River Reservoir area, northwest of Carey.
Do	Raising the earthfill Little Wood River Dam 42 feet and constructing a spillway and an addition to the outlet works. On the Little Wood River, northwest of Carey.
Middle Rio Grande, N. Mex.	Clearing, cleaning, and shaping about 31 miles of open ditch laterals, removing existing structures and constructing new structures. Near Belen.
Missouri River Basin, Colo.	Additions to the Loveland, Longmont, Erie, and Prospect Valley Substations.
MRB, Kansas	Earthwork and structures for about 19.5 miles of canal and laterals with capacities varying from 140 to 6 cfs. Courtland Canal, Section B5, near Scandia.
MRB, Nebraska-Kansas.	Furnishing and installing 5 fixed radio stations and 25 mobile sets. No houses will be required. At Courtland, Kansas, and Franklin, Red Cloud, Superior and Cambridge, Nebraska.
MRB, Minnesota	Additions to the Granite Falls Substation.
Do	One 3-phase, 110/69/13.2-kv, 25,000-kva transformer, for the Granite Falls Substation.
MRB, North Dakota.	Additions to the Jamestown and Fargo Substations.
MRB, Montana	Earthwork and structures for about 5 miles of open ditch laterals with bottom widths varying from 6 to 4 feet in the Spokane Bench and North Side areas of the Helena Valley Unit, near Helena.
MRB, Wyoming	Hydraulic control systems for 144-inch butterfly valves and 14- by 18-foot fixed-wheel gate at Fremont Canyon Powerplant.
Rogue River Basin, Oreg.	Constructing an earthfill dam structure over and around the existing concrete arch Emigrant Dam to a height of about 79 feet above the existing crest, constructing 3 earth dikes, concrete emergency spillway and concrete outlet works. On Emigrant Creek, southeast of Ashland.
Do	Constructing the concrete Ashland Diversion Dam, 8.5 feet high with uncontrolled overflow crest 65 feet long, and an earthfill dike extension, constructing a canal headworks structure and constructing about 3 miles of open ditch lateral, and three 48-inch-diameter siphons and other appurtenant reinforced concrete structures. Near Ashland.
Do	Constructing the 115- to 85-cfs-capacity Dead Indian Collection Canal, about 3,000 feet long, a rockfill-type diversion dam about 5 feet high and 100 feet long and headworks structure; constructing the 25-cfs-capacity Conde Creek Collection Canal, about 2.5 miles long, a rockfill-type diversion dam 5 feet high and 75 feet long and headworks structure; and constructing improvements to the Grizzly Creek Channel, about 1.5 miles long. About 15 miles northeast of Ashland.
Do	Constructing about 3 miles of 6-foot bottom width unlined canal. Work will include constructing about 700 feet of 6-foot width rectangular concrete bench flume, and two 42-inch-diameter concrete pipe siphons totaling about 2,700 linear feet long. South Fork Collection Canal, about 25 miles east of Medford.
Do	Constructing an access road to the Howard Prairie Dam site, about 27 miles east of Ashland.
Do	Clearing the remaining scattered areas of the Howard Prairie Reservoir site, about 27 miles east of Ashland.
Wapinitia, Oregon.	Clearing about 298 acres in the Wasco Reservoir area, about 35 miles west of Maupin.
Washita Basin, Oklahoma.	Constructing the 136-foot-high earthfill Foss Dam, about 18,000 feet long, including spillway and multipurpose outlet works. On the Washita River, about 18 miles northwest of Clinton.
Do	Constructing a field office, laboratory, pump house including domestic water, sewage disposal and liquified petroleum gas systems. At the Foss Dam site, about 18 miles northwest of Clinton.
Weber Basin, Utah.	Constructing 8 rectangular, earthlined reservoirs; 6 having 20 acre-feet capacities and 2 having 12 acre-feet capacities. Bountiful Subdistrict, near Salt Lake City.
Do	Constructing 4 pumping plants consisting of 2 outdoor, sump-type plants of 8- and 13-cfs capacities, an outdoor, flat-slab-type plant of 4-cfs capacity, and an indoor-type plant of 5-cfs capacity. Work will also include constructing about 4 miles of 16- to 36-inch-diameter reinforced concrete, pretensioned reinforcement (steel cylinder type) and steel pipe discharge lines and trunklines. Sand Ridge, East Layton and Val Verda Pumping Plants, between Salt Lake City and Ogden.

*Subject to change.

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The Reclamation Era

AUGUST 1958

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Official Publication of the Bureau of Reclamation

The Reclamation Era

AUGUST 1958 **Volume 44, No. 3**

COVER SKETCH: FLAMING GORGE DAM

J. J. McCARTHY, Editor

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Roads To Scenic Treasures

Located at the hub of Utah's spectacular Monument Valley, Arizona's Painted Desert, Bryce Canyon National Park, and Grand Canyon National Park, the 700-foot-high Glen Canyon Dam will harness the flow of the Colorado River and unlock a treasurehouse of resources in the center of an area unmatched for pure scenic beauty by almost any other part of America.

The long geologic evolution of the Colorado Plateau has produced colorful valleys punctuated by towering monoliths, craggy-toothed edges of eroded monoclinal folds, domes, and uplifts—all occasionally shattered open by gorges gouged hundreds of feet deep into the earth.

Nature's paintpot has splashed the panorama with colors ranging the spectrum from Vermillion Cliffs to chalk-white Castle Rocks, with changing colors each hour of the day—at night turning into a weird, spectral goblinland under moonlight.

While Mother Nature was providing the American scene this vast panorama of scenic splendor she, perhaps thoughtlessly, provided Reclamation engineers their best site for the key structure of the Upper Colorado River development at the hub of this rugged area.

Five years ago only the chosen few, willing to spend extra dollars, ventured into the center of this color kingdom by riverboat or packhorse train. Now, a hundred diesel-powered trucks roll to and from the dam site area every day via newly completed access roads. Future travelers will be availed of the spectacular beauty of this wonderland via modern new routes. Based on recreational usage of Lake Mead and other Reclamation reservoirs, tourist visitations will skyrocket the area's public usage.

by L. F. WYLIE, Project Construction Engineer, Glen Canyon Storage Unit

The logistics involved in the construction of Glen Canyon Dam are comparable to those of any army fighting on two fronts—these fronts being separated by only 1,200 feet of Colorado River gorge. Men and materials must move to the dam site from two directions—Flagstaff, Ariz., 135 miles to the south, and Kanab, Utah, 76 miles west. Railheads are located at Flagstaff and at Marysvale, Utah, 190 miles to the north. Because of the high cost of construction and maintenance of branch railways, access roads to the existing arterial highways were the only answer to the logistics problem.

In an all-out cooperative effort to quickly provide access to this inaccessible dam site, the first major Bureau dam not serviced by rail connections, the States of Utah and Arizona, the Bureau of Reclamation and the Bureau of Public Roads will have spent some $12.8 million on roads by the end of this calendar year. During the construction period of the dam and powerplant more than three quarters of a million tons of materials will be trucked into the dam site over these access roads.

Early in the planning of the project the Reclamation engineers saw that the cost of the dam and associated works would be substantially reduced if, during the construction period, a bridge spanned the gorge to tie the two access roads together and permit easy crossing of the canyon for men and materials.

Installing curbing on Bitter Springs—Page access road.

The proposal for a high steel bridge and highway access created much interest in the highway departments of Arizona and Utah, as well as in the Bureau of Public Roads. Long-range planning was essential, they felt, if the public interest was to be best served before, during and after the construction of the dam and powerplant.

Negotiations by these agencies produced a three-way financial plan whereby Arizona and the Bureau of Public Roads would participate in the construction of a highway bridge over the Colorado River. Arizona would bear a portion of the cost of a 25-mile access highway from U. S. Highway 89 at Bitter Springs to the dam site, and would build 9 miles of permanent highway from the Utah-Arizona line to the dam site on the opposite side of the canyon.

Seventeen miles of Glen Canyon—Kanab road through Cockscomb Mountains will cost almost $2 million.

Glen Canyon site shows marks of construction progress. Note suspension footbridge in foreground.

With these proposals in writing, the State of Utah made plans for a 56-mile highway from the dam site west to Kanab, Utah, to link the road with Highway 89.

The cooperative agreement on the Colorado River Bridge and the 25-mile access highway from Bitter Springs to Page, Ariz., left the engineering and invitations to bid to the Bureau of Reclamation.

In the meantime, work at the dam site could not be delayed waiting for a highway. Early in 1956 Utah laid out the road from Knab to the Utah-Arizona line, and the Bureau built a temporary road the remaining 9 miles to the site. At the same time, Arizona graded a 50-mile road from "The Gap" on U. S. Highway 89, providing access to both sides of the Colorado River.

By the time the first contracts for exploratory drilling and one water diversion tunnel were awarded, speed in road construction had become essential. Heavy equipment moved to the dam site over roads still under construction, and both men and machines were often marooned by destructive flash floods.

The contract administered by the Bureau of Reclamation covering construction of a 25-mile highway from Bitter Springs to Page, was separated into three parts. Construction of the roadbed to subgrade of the first 5 miles, which included a 300 foot deep cut through the Echo Cliffs, was awarded to Strong Construction Co. of Springville, Utah. The contract for construction to subgrade of the remaining 20 miles, which included a highway bridge over Waterholes Canyon, was awarded to W. W. Clyde & Co., also of Springville. Surfacing and application of seal coat and chips was done by Alexander Construction Co. of Minneapolis, Minn. This firm is also required to furnish a stockpile of crushed rock and chips for the surfacing of the streets of Page. This Bitter Springs highway was opened to traffic last January.

On the opposite side of the Colorado River, the State of Utah pressed for early completion of the 56-mile highway to Kanab. Bridges over the Blue Pools Wash, Paria River, and the Buckskin Wash are now completed. Excavation has begun for the roadbed through an upturned and eroded monoclinal fold known as the Cockscomb. Utah Highway Department officials expect the entire highway to be completed by early fall of this year. To tie Utah's highway to the dam site, the Bureau of Reclamation built a temporary 9-mile oiled road from the State line to the construction area, which will later be brought up to Federal highway standards by the State of Arizona.

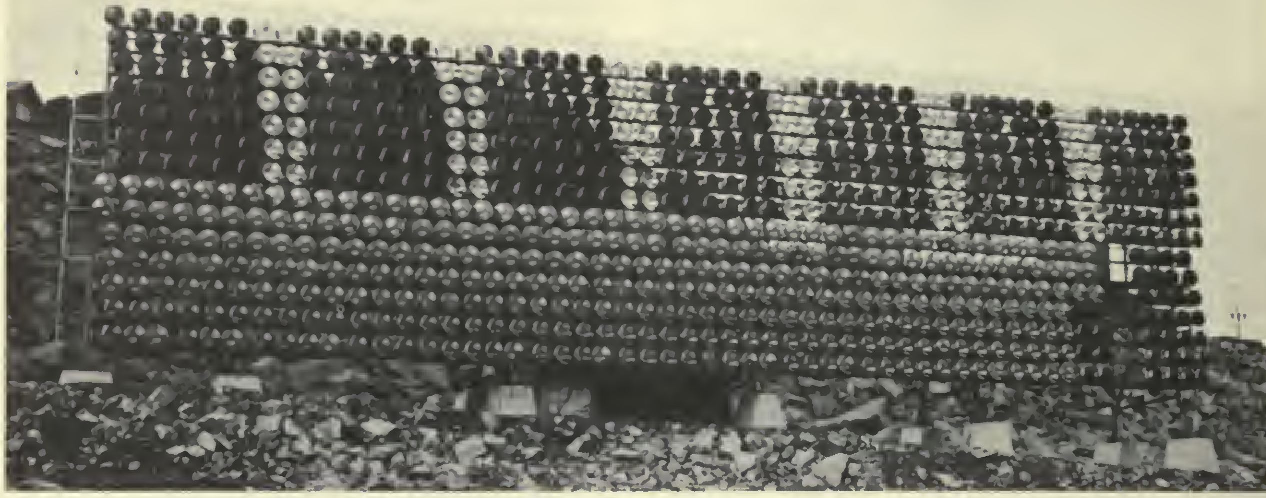
Roadbuilding in the Colorado Plateau country is no easy task in any language, and is costly. Averaged out over the 101 miles from Bitter Springs, Ariz., to Kanab, Utah, the highway will cost almost $127,000 a mile. Most expensive, of course, is the one-quarter mile of bridge over the Colorado River, which will cost in excess of $4 million. The usefulness of these facilities will live far beyond the project's construction period, however, and will remain to serve future travelers.

By February 1959, the Kiewit-Judson Pacific Murphy Co., builders of the Colorado River Bridge, will have completed the concrete deck over the Glen Canyon gorge. The Utah State Highway Department will have completed the west leg of the access highway from the dam site to Kanab by the end of this year. Then the men and materials required for Glen Canyon Dam will move swiftly and directly to their destination, in the center of what was once an impenetrable desert.

#

L. F. (Lem) Wylie, Project Construction Engineer, Glen Canyon Storage Unit.

Columbia Basin Colorama



These varicolored lights play on Grand Coulee spillway.

The 3-day Colorama Festival opened on May 30 with a note of solemnity at a Memorial Day ceremony on the roadway atop Grand Coulee Dam. Gayer festivities got underway about 2 hours later with a rodeo parade signaling the start of the first day's activities. The highlight of the first day of the celebration was the official lighting ceremony at the new Coulee Dam tour center. A crowd of approximately 25,000 people gathered to witness the turning on of the new floodlights designed to bathe the spillway of Grand Coulee Dam in colorful hues.

Columbia Basin Project Manager Phil Nalder, acting as master of ceremonies, introduced more than 65 prominent persons associated with the Columbia Basin project. Harold T. Nelson, Bureau of Reclamation Regional Director from Boise, Idaho, gave a brief history of the project to start the speaking portion of the program. The junior senator from the State of Washington, Henry M. Jackson, also spoke, remarking that he hoped that the ceremony would make more people conscious of Grand Coulee Dam and the need for more power developments.

Secretary of the Interior Fred A. Seaton, as emissary of President Eisenhower, delivered the principal address. The highlights of Secretary Seaton's remarks were that the ceremony of color floodlighting the dam for the first time served to emphasize the many benefits coming from this triumph of civilization, and a monument to the ingenuity of American technologists. Secretary Seaton promised the people that the Grand Coulee Dam area would have more recreational developments in the near future along the 600-mile shoreline of Lake Roosevelt.

With the words, "I now have the honor and pleasure by this act of formally floodlighting the Grand Coulee spillway," Secretary Seaton pressed the button to start the floodlights through their 30-minute cycle. The lighting system which Secretary Seaton formally placed in operation is composed of 742 1,500-watt globes, each about 24 inches in diameter. The 90-foot long, 20-foot high, bank of lights contains 112 red, 336 blue, 98 green, 112 amber, and 84 white lights. The lights are so aimed that the entire spillway is lit with

Spectacular view of Grand Coulee from Douglas Memorial Park.

the same intensity at all times, no matter how many of the lights are on.

Later in the evening, Secretary Seaton crowned Miss Peggy Brown of Grand Coulee as the 1958 Queen of Lights.

The second day of festivities started with a Colorama Parade which took 1 hour to pass any given point and was viewed by over 10,000 enthusiastic onlookers, even though a hard rain fell during the parade and the rest of the day.

The Colorama Festival was the result of a community-spirited idea. Late in 1957 several civic and fraternal organizations comprised of members from Electric City, Grand Coulee, Coulee Dam, and Elmer City decided that inasmuch as the lights had been installed as a result of community agitation there should be a celebration. The Coulee Dam Lions Club assumed the responsibility for arranging for such a celebration and appointed Bill Gould of Grand Coulee as their Colorama Festival chairman. With the active support of the majority of the people, the festival became overnight a medium by which the communities of the Coulee Dam area could be brought together for a single purpose. Because of the success of this year's festival, plans are already underway for next year's event and it is hoped that the festival will become an annual attraction, signaling the start of the summer tourist season in the State of Washington.

Colorama princesses pose with Grand Coulee power supervisor Al Darland.

The Crow Creek Pump Unit is coming of age. Facilities to serve 5,000 acres were completed in 1954. Today, water has been contracted for 4,247 acres and a strong demand for the small balance of the water available under the present designed capacity. There is little doubt that the acreage could be expanded considerably beyond the 5,000 acres the unit is now prepared to serve.

The unit is located on the main stem of the Missouri River near Toston, Mont. Water is pumped 175 feet above the river, tunneled 2,164 feet through high ground bordering the river, and distributed to the unit through gravity canals.

Peggy Brown of Grand Coulee crowned Queen of Lights by Secretary of the Interior Fred A. Seaton.

CROW CREEK IS GROWING UP

When Congress authorized the construction of a high dam at the Canyon Ferry site and its operation at the 3,800-foot level, a stipulation provided that an acreage equal to that inundated by the additional storage would be irrigated in Broadwater County, Mont. Crow Creek Unit was constructed because of that provision; thus, the usual preconstruction requirements of an organized irrigation district and an executed repayment contract was waived. Public Law 374 (84th Cong., 1st sess.), approved August 12, 1955, authorized the Secretary of the Interior to execute a temporary water service contract for a period of not to exceed 10 years with the Toston Irrigation District. This legislation and the temporary contract subsequently executed with the district contemplate the ultimate negotiation of a long-term contract under which the district will assume its proper repayment obligation under the reclamation laws. The first water was available in 1955.

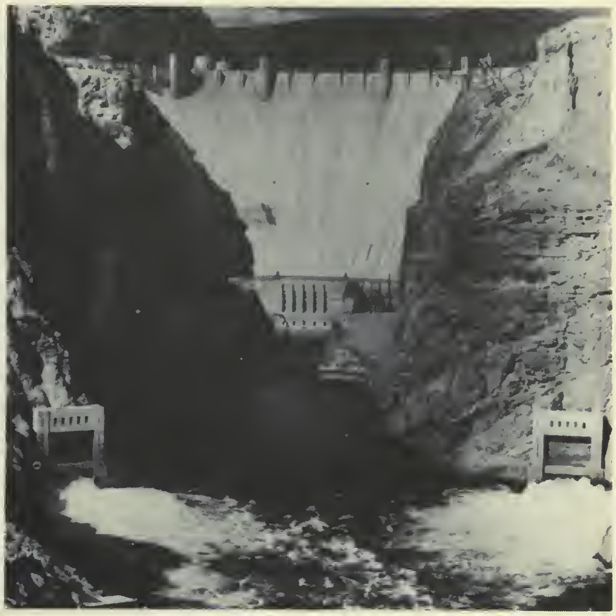
When the Toston Irrigation District was formed in July of 1955, it included only 1,543 acres. In April 1957, additional landowners petitioned the district court for admission into the district. The petition was granted and the total of lands in the district was increased to 4,247 acres.

Although the lands petitioning for eventual admission into the district brought the total to 4,247, the landowners requested that certain of

Continued on page 80

by C. L. CONAWAY, Publications Officer, Interior Missouri Basin Field Committee, Billings, Mont.

Grand Coulee Dam (above) and Hoover Dam (right) are tabbed outstanding achievements in field of civil engineering.



Two Reclamation Structures Receive ASCE Plaques

In 1955 the American Society of Civil Engineers selected two Bureau of Reclamation projects as being among the "Seven Modern Civil Engineering Wonders of the United States." The structures were Hoover Dam in Arizona and Nevada, and Grand Coulee Dam of the Columbia Basin project in Washington (see p. 6, *Reclamation Era*, February 1956).

This spring President Louis R. Howson of the ASCE honored both of these structures by presenting bronze plaques to Reclamation Commissioner Dexheimer for Hoover Dam and Project Manager Phil Nalder for Grand Coulee Dam and the Columbia Basin project. The following is an account of the presentations:

HOOVER DAM

A bright new bronze plaque glistens in the desert sunlight from its concrete pedestal on the Arizona-Nevada boundary line atop Hoover Dam.

The plaque records the fact that this first of Reclamation's great multipurpose dams was selected by the American Society of Civil Engineers as one of the "Seven Modern Civil Engineering Wonders of the United States."

Louis R. Howson, president of the ASCE, formally unveiled the plaque last April 16 and presented it to Reclamation Commissioner W. A. Dexheimer, who accepted it for the Bureau.

Some 400 people, including engineers and "construction stiffs" who helped build the dam, gathered on the roadway in the bright morning sunshine to witness the unveiling. Some of these men had not been back to the dam site since the project was completed. It was a homecoming for all. Millions of other Americans saw the unveiling on television and in newsreels or read about it in magazines and newspapers throughout the Nation.

Commissioner Dexheimer described the Seven Wonders Award as "the highest single honor bestowed upon Hoover Dam since its dedication September 30, 1935."

"We of the Bureau of Reclamation share this honor with the American people," he declared. "We should all remember and honor men like Walker R. "Brig" Young, the Bureau's construction engineer on the job; the late Frank T. Crowe, construction superintendent for Six Companies, Inc., and other engineers. Many others and particularly the workers, the "construction stiffs," are honored for the blood and sweat that went into the building of Hoover Dam."

Commissioner Dexheimer noted that the

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ASCE plaque atop parapet of Hoover Dam.

workers in the steel mills of Pennsylvania, the cement plants of California, and in hundreds of other industrial plants and factories throughout the Nation joined with those at the dam site to build the world's highest dam.

"This truly was one of the finest examples of cooperation between the Federal Government and private enterprise," he said. "To those planners and builders of Hoover Dam we dedicate this Seven Wonders Plaque."

Commissioner Dexheimer said that 6 million people in the Southwest depend on Hoover Dam to control floods, protecting their lives and property; to store water for their homes, factories, and crops.

"They look to Lake Mead and downstream reservoirs for recreation and as habitats for fish and wildlife. They welcome the power generated at Hoover and other Colorado River dams to light their homes, offices, and factories; pump their water and operate their many electrical appliances," he said.

Commissioner Dexheimer called attention to the current construction by the Bureau of Glen Canyon Dam, 370 miles up the Colorado River from Hoover Dam.

"Within a few years Glen Canyon will join with Hoover in harnessing the floodwaters and the power of the mighty Colorado," he commented. "Between Glen Canyon Dam and Hoover Dam, man someday will build other great dams in Marble and Bridge Canyons to complete the stairway of dams from Glen Canyon to the Gulf of California."

President Howson paid high tribute to the vision and technical skill of both Reclamation and Six Companies, Inc., engineers. He pointed out that Hoover Dam was selected because it was the first of the great multipurpose dams. Clarence Whalin, Phoenix, Ariz., president of the Arizona section of ASCE presided, and Samuel B. Morris, vice president of ASCE, Los Angeles, Calif., was master of ceremonies. Walter H. Cates, Los Angeles, president of the Los Angeles ASCE section, explained the local ASCE participation in the ceremony.

Mr. Morris introduced honored guests which, in addition to those on the program, included Reclamation's Associate Chief Engineer, E. G. Nielsen, who represented Assistant Commissioner and Chief Engineer Grant Bloodgood; W. H. Taylor, Director of the Bureau's Region 3; L. J. Hudlow, Boulder Canyon Project Manager; E. A. Moritz, formerly Director of Region 3; L. R. Douglass, formerly Boulder Canyon Project Director of Power; Burton S. Grant, Assistant General Manager of the City of Los Angeles' Department of Water and Power; William H. Wisely, executive secretary, ASCE; R. Robinson Rowe and Finley B. Laverty, directors of district 11, ASCE; and A. E. Cahlan, editor of the Las Vegas Review-Journal. Also acknowledged were A. E. Hamilton, superintendent of the Department of

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Reclamation Commissioner Dexheimer accepts Hoover Dam plaque unveiled by ASCE President Howson.

RESERVOIRS BRING BIG RECREATION GAINS

Becoming an Admiral in the "Nebraska Navy" used to be a pretty fair joke in a State boasting no sizable body of water.

The irony no longer fits southwestern Nebraska, where watercraft now number in the thousands, and it's a man's own fault if he isn't an admiral, at least in his own household.

Southwestern Nebraska has gone boat-mad, like the rest of the United States. And what makes the mania practical, in the 19-inch rainfall belt, is the existence of 3 new reservoirs.

The 3 would be encompassed by a 60-mile circle drawn around McCook—Harry Strunk Lake, covering 1,768 acres behind Medicine Creek Dam on Medicine Creek; Enders Reservoir, covering 1,707 acres behind Enders Dam on Frenchman Creek; and Swanson Lake covering 4,974 acres behind Trenton Dam on the Republican River.

These Bureau of Reclamation reservoirs, constructed for irrigation, flood control, and other multiple uses, were completed between 1949 and 1953. Sufficient time having passed for filling, and for stocking and growth of 2.5 million game fish, the lakes are now gathering spots for thousands who had always thought of water recreation as being somewhere else.

Nature has provided the wherewithal for recreation in many parts of the United States—seashores, mountains, and big lakes or rivers. In the corn and cattle country of western Nebraska,

by ROBERT J. STEINBRUNER, Field Liaison Officer, Region 7, Bureau of Reclamation, Denver, Colo.

Good fishing at Inlet to Swanson Lake.

recreation facilities have to be manmade. The lakes are no exception.

Through the Republican Valley Conservation Association, the people crusaded for control of their limited water resources, to convert hazardous dry farming areas into stabilized irrigation farming and to stop the repeated ravaging by floods.

Farmers and townfolk know the main purposes of the reservoirs; they know the lakes' importance to economic living.

But there's also just plain living—direct, unqualified enjoyment of the new water areas.

There's a big gap between existence of bodies of water, and facilities to enjoy them—such as adequate roads, drinking water, picnic tables, boat ramps, sanitary facilities, etc.

That a reasonable amount of recreation facilities exist to meet the public need at Swanson, Enders, and Harry Strunk Lakes, in so short a time, is a tribute to the agencies and individuals who, with the best of good will, have worked their way through many delays and frustrations.

The starting point of fulfillment was a "reservoir management plan" for each reservoir and the willingness of the Nebraska Game, Forestation, and Parks Commission to accept the responsibility for administration of the areas for wildlife and recreation.

The agencies carefully studied the pattern and cover of the shores to determine the most suitable locations for day use, cabin sites, organized group camps, and wildlife areas.

The National Park Service planned the recreation phase of development including such things as interior access roads, boat ramps, picnic tables, fire grates, sanitary facilities, swimming, beaches, cabin and club sites, and shade-tree plantings.

Minimum facilities for the protection of public health and safety and Government property were provided as part of the reservoir construction and located to tie in with the overall plan of recreational development.

The Fish and Wildlife Service counseled about the variety and location of vegetative plantings for wildlife, beautifying shores that in natural state would be nearly barren. The Soil Conservation Service was concerned with basic land-use capabilities and recommended needed soil erosion control measures, such as terracing, revegetation, proper grazing, and agricultural practices.

Agricultural and grazing permits, and also cabin leases and concessions, yield revenues which the Nebraska Commission plows back into the areas. The commission maintains a three-man crew headed by Melvin Grim for year-round administration, and in addition hires seasonal labor.

Working arrangements between the agencies concerned are most amicable at the local level between headquarters offices of the agencies.

All officials would be quick to affirm that many additional improvements are in order.

Organizations in nearby communities are doing what they can to add to the facilities. The most notable contribution is a fine picnic shelter at Swanson Lake, constructed jointly by the Trenton Chamber of Commerce and the parks commission.

Hunters land in stubble field by Harry Strunk Lake.

Northern Pike and Bluegill fill creels at Swanson Lake.

An Izaac Walton League chapter has erected an attractive clubhouse at Enders, and a number of good-quality cabins have been built by private individuals, especially at Swanson and Enders.

Off for a spin around Swanson Lake.

Fortunately, one reservoir benefit requires little or no investment—duck hunting. The new bodies of water attract vast flocks of ducks for shooting on the reservoir marshes or along the rivers where few ducks formerly came. Quail, deer, and other game love the wildlife habitat plantings.

Melvin Steen, Director of the Nebraska Game, Forestation, and Parks Commission at Lincoln, and R. J. Walter, Jr., Director of the Bureau of Reclamation at Denver, believe a wonderful job has been done for the public.

The Nebraska admirals and their families—the 350,000 people who used the reservoirs for recreation each of the last 2 years—know best of all that recreation is an additional dividend resulting from construction of irrigation and flood control reservoirs in the arid west. ###

"Rx JELLY BALLS"

"Two cups, three times a day." Would you prescribe "Jelly Balls" as a reducing diet?

The name, courtesy of Mr. Frank McDonald of Southern Okanogan Lands project, Oliver, British Columbia, aptly describes the green pea, green grape, green olive shaped balls which move freely in the water of irrigation projects. "Jelly Balls" are common but are seldom recognized as the alga: *Nostoc*. They are probably never harvested for human food. They are better known for their capabilities of plugging such small openings as siphon tubes, spiles, screens, and sprinkler systems.

"Jelly Balls" are free floating forms of blue-green algae. Their skins are tough and their insides are of the consistency of sun-ripened grapes. With a certain amount of drying to further toughen the skin, "jelly balls" present a dietary amendment high in protein—low in carbohydrates super-charged with chlorophyll and wrapped in its own discrete package. Here is a crop already processed ready for national advertising. The flavor leaves something to be desired, but then it's simply a matter of taste. Consider the adherents to the distinctive flavors of broccoli, okra, and spinach, not to mention lutfisk or boiled cabbage.

On the Columbia Basin project, Washington, "Jelly Balls" have not been harvested. Tons of the little green spheres lie in the waterways drying to the consistency of raisins. Their nitrogen fixing skills serve only to enrich the bottom silts and to further encourage the invasion of the submersed pondweeds.

In Washington as in British Columbia, copper sulfate at one-third pound per cubic foot of water per second controls "Jelly Balls" and the filamentous green algae.

The foregoing item was made available to the Era through the courtesy of Mr. Delbert D. Suggs, Weed Specialist, Columbia Basin project, Washington. #

FIRST SMALL PROJECT LOAN O. K.'d

Secretary of the Interior Fred A. Seaton recently approved the first contract for repayment of a construction loan under the Small Reclamation Projects Act.

The contract is between the Bureau of Reclamation and the Cameron County Water Control and Improvement District in Harlingen, Tex.

The work contemplated by the Cameron County District in the rehabilitation and betterment of the existing nonfederally constructed system serving some 39,000 acres of land from a pumping plant on the Rio Grande River, about 12 miles southwest of Harlingen. No new irrigation is planned.

Witnessing the signing was a bipartisan group of Senators and Congressmen from among those who had sponsored the Small Reclamation Projects Act of 1956. Standing (L. to R.) Hon. Wayne N. Aspinall, Colorado; Dr. A. L. Miller, Nebraska; Senator Frank A. Barrett, Wyoming; Senator Arthur V. Watkins, Utah; Senator Clinton P. Anderson, New Mexico; and seated on Secretary Seaton's right is Hon. Joe M. Kilgore of Texas.

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If you have friends or associates who would be interested in the RECLAMATION ERA, please send their names and addresses to the Bureau of Reclamation, Washington 25, D. C. We shall be glad to send them copies of back issues.

CORROSION, A FORMIDABLE ENEMY

The economic and material loss through the corrosion of metals is a tremendous amount each year. These losses may be divided into two groups, direct and indirect costs.

The direct costs consist largely of the protection and replacement of corroded equipment or structures. The amount has been estimated as more than $6 billion annually for the United States alone.

The indirect costs have never been satisfactorily estimated. It is known that the amount is tremendous. Indirect costs include such items as conservative design when the rate of corrosion is unknown, replacement and duplication of equipment such as pumps, pipelines and numerous kinds and types of installations in order to insure continuous service when failures occur. To the above can be added the loss of life and limb, resulting from unpredicted failures, explosions, wrecks and many other costly catastrophes.

There are many ways open for combatting corrosion and one is the proper choice of metals. The selection of the proper metal for reducing corrosion to the minimum under specific conditions requires careful study. The first cost of stainless steel may be 4 times that of other steel but under proper conditions can increase the life of a piece of equipment 20 times. The same can be said of other metals such as silver, copper, brass and aluminum under chosen conditions. For instance, aluminum may last indefinitely under particular atmospheric conditions but under certain soil conditions corrodes very rapidly. The combining of metals with different rates of corrosion should be done with care. As for example a copper service pipe from a steel main into a building may produce a condition ideal for electrolytic action and cause portions of the main to corrode rapidly. A brass valve seat may remain in good condition at the expense of some other portion of the valve. The same may be true of stainless steel in combination with other types of steel.

The most popular and in many instances, the most economical way of preventing corrosion is by the proper selection and application of protective coatings. There seems to be no end to the types and varieties of these coatings. Some of

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THE LID'S ON **EVAPORATION**

"The tun (head cavity) of the whale contains by far the most precious of all his oily vintages, the highly prized spermaceti," wrote Herman Melville in his classic 19th century whaling story, *Moby Dick.* Melville's words have particular meaning today, as research by Reclamation scientists indicates that the spermaceti, or sperm oil, of the whale may influence the control of evaporation from reservoirs. If this research is successful, the results will add significantly to the available water supplies in the West and elsewhere.

From spermaceti comes the compound cetyl alcohol, which research shows forms on the water surface a film, or monomolecular layer—an invisible shield between the water and the surrounding air, 1 molecule or about 6 ten-millionths of an inch thick. Cetyl alcohol, also known as hexadecanol, thus has the ability to reduce evaporation from a water surface.

The monomolecular layer is formed by long molecules alining themselves side by side with the water-loving, or hydrophilic ends of the molecules dipped into the water and the water-fearing, or hydrophobic, ends out of the water. When a small amount of hexadecanol is placed on a water surface the molecules stream off onto the surface, alining themselves similar to paper matches in a matchbook and forming an invisible but tough and pliable "lid" on the water surface.

In the arid West, reservoir evaporation reduction is vitally important. One western city alone loses each year approximately 11,000 acre-feet

Photo above—Research in evaporation-preventing chemical films reveals promising results.

by Q. L. FLOREY, Physicist, Bureau of Reclamation, Denver, Colo.

Reclamation research team of Timblin and Florey check results at Rattlesnake Reservoir.

Smooth water surface in foregrou

Reclamation physicist Florey examines flake hexadeconal refill for the dispenser in water.

or 3.6 billion gallons of water through evaporation—enough water to supply, on the average, the full municipal needs of 44,000 persons for a year. In the Western States, losses due to evaporation from water surfaces average 11.5 million acre-feet a year—which is underscored by the fact that prices of irrigation water in the West range from \$1 to \$40 an acre-foot, and that the cost of municipal reservoir water varies from \$10 to \$80 an acre-foot.

The study of monomolecular layers is not new. For more than 30 years it has been known that layers of certain compounds retard evaporation from water surfaces under laboratory controlled conditions. The "how to do it" is the most difficult part of the development, and has occupied the Bureau researchers' attention since the spring of 1952.

Why is hexadecanol high on the researcher's list of evaporation suppressors? Bureau studies of 125 materials tested show that as much as 65 percent of evaporation can be eliminated under controlled laboratory conditions by placing and maintaining a film of hexadecanol. The chemical is also desirable because it will not react with hardness chemicals in water to form a solid layer which is easily fractured by wave action and quickly loses its ability to reduce evaporation.

resence of monomolecular layer.

Compression of monolayer is determined by the spreading of calibrated oils.

Most important, hexadecanol does not affect the quality of water treated nor the biological elements in water. The Food and Drug Administration of the Department of Health, Education, and Welfare has given full clearance from the standpoint of nontoxicity to human beings for use of hexadecanol in the quantities that would be used in reservoir studies. Reclamation studies have also indicated that hexadecanol is not harmful to fish, fowl, or aquatic plants. These biological investigations are continuing at the Colorado State University.

The Bureau early recognized that to evaluate the effect of monomolecular layers in large scale application to water surfaces, tests would have to be made on a large reservoir where the inflow and outflow of water are acurately known. Such a reservoir is the 2,500-acre Lake Hefner of the Oklahoma City municipal water supply system. A committee was subsequently formed to examine the effects of hexadecanol on water quality of the city's reservoir. On the committee are representatives of the Bureau of Reclamation, United States Geological Survey, City of Oklahoma City, Oklahoma State Department of Health, and the United States Public Health Service and its Robert A. Taft Sanitary Engineering Center.

The committee decided that the effect of hexadecanol treatment upon water quality should be tested first at Kids Lake, a 6-acre body of water adjacent to Lake Hefner. The Kids Lake studies, carried out during the summer of 1956, indicated that water quality was not affected, insofar as taste, odor, color, and toxicity were concerned, and that the Lake Hefner large-scale evaporation studies should proceed.

The Kids Lake investigations also demonstrated that there was need for improving the techniques

Hexadeconal covered this shining area of water within 15 minutes.

Almost entire surface area of Denver's Ralston Creek Reservoir is covered by the water-saving layer.

of applying hexadecanol, maintaining the monomolecular layer, and detecting its presence. This need led Reclamation researchers in the Bureau's Denver Engineering Laboratories to develop a set of calibrated indicator oils which contain a mixture of mineral oil and an alcohol. Using these oils they can determine not only the presence of the monomolecular layer of hexadecanol but also whether it is sufficiently compressed to exert an evaporation retardation effect.

For field confirmation of the laboratory tests the laboratory scientists in the spring of 1957 went to the 100-acre Rattlesnake Reservoir on the Colorado-Big Thompson project near Loveland, Colo. Here, the studies of application techniques included shoreline dispensers in which particles of hexadecanol were confined in brass screening, floating cakes of hexadecanol, and broadcast application of powdered hexadecanol. The researchers concluded that a broadcast application of the powdered hexadecanol gave best results. The oils for detecting the monolayer and its compression were tested and proved satisfactory for further use.

Approval was given in the late summer of 1957 by the Denver Water Board to allow the Bureau to carry out additional studies at the 150-acre Ralston Creek Reservoir, a part of the Denver water system about 10 miles from Denver. At this reservoir, application of powdered hexadecanol has been further investigated, as well as the action of the monomolecular layer under the influence of wind, waves, and sunlight. From these studies together with further laboratory investigations now underway will come definite recommendations on the most effective hexadecanol dispenser, how many dispensers are needed, and where they should be placed to maintain the film of the chemical on the reservoir's surface.

Tests are now in progress to evaluate the feasibility of treatment of large reservoirs with hexadecanol or similar materials. Before a reservoir can be treated, it will be necessary to make a study of the costs and methods for treatment, benefits to be derived from the water saved, etc., to determine the praticability of the treatment.

In the months to come, hexadecanol may have great significance to western water resource developments which will rely on this chemical to reduce evaporation. If only a small percentage of the evaporation can be reduced from the West's many reservoirs, potentially millions upon millions of gallons of precious water can be conserved. Substantial contribution to saving the West's precious water supplies may be realized.

# # #

Hexadeconal dispenser is simple device and easily recharged with chemical.

YOUR MAGAZINE

Are there particular types of articles which you would like to see in the ERA that we have not printed to date? If so, please let us know, and we shall do our best to comply with your wishes.

Heart Butte Scout Reservation—

A Resource Development for Youth

by G. A. FREEMAN, Irrigation Division, Missouri-Souris Projects Office, Bismarck, N. Dak.

The Bureau of Reclamation constructed Heart Butte Dam in southwestern North Dakota, and it is one of the components of the Missouri River Basin project. It has already proven itself as a flood control structure, is furnishing a water supply for irrigation, and the recreational values have far exceeded original expectations. Working in cooperation with the Fish and Wildlife Service, the National Park Service, and the North Dakota Game and Fish Department, plans are well underway to develop and encourage public use of the area. A big boost was given to this area when the Missouri Valley Council of the Boy Scouts announced its plans for a scout reservation in this area. It plans to invest $110,000 to develop it.

"Look Over This Wonderful Project—

"You'll be as excited as we are" is the front page caption of the scouts' eye-catching brochure announcing their development plans for the Heart Butte Scout Reservation. The Missouri Valley Council represents the Scout movement in 20 counties in southwestern North Dakota and 2 counties in northwestern South Dakota. Seeking a better and permanent summer encampment area, the council reviewed several possibilities and decided that Heart Butte Reservoir afforded the best opportunities for a number of important reasons. Heart Butte Dam, completed in 1950, is located approximately 60 miles southwest of Bismarck, N. Dak. The lake, created by the dam, varies in width up to 2 miles, and is from 6 to 8 miles in length. The rolling terrain adjacent to the lake, plus a number of well-sheltered bay areas, have created an ideal group camping site for this Boy Scout organization. Three hundred and sixty acres of acquired lands, providing approximately 3 miles of reservoir shoreline, has been leased.

Local Scout officials and leaders, quick to realize the potential of this excellent site and its importance to scouting youth in their council area, set forth an ambitious program of development. Mr. A. W. Klick, veteran scouter and vice president of the council, was selected as campaign manager. He outlined detailed plans for a brick constructed central service lodge, 20 patrol shelters, a water-supply system, roads and trails, council area, archery ranges, beaches, docks, and other details to accommodate up to 1,500 Boy Scouts.

Amid these plans for improved physical fa-

Scouts learn practical rules of boat handling and safety.

Troop 10 Scouts receive instruction at Heart Butte outing.

cilities a unique conservation phase of reservation development also came forward. Two prominent men in tree culture for the Great Plains and scout enthusiasts Elmer Worthington and George Will, Jr., of Bismarck, developed a tree-planting program called "Operation Tree Lift." Thousands of trees were planted during 2 weekends in May 1957, and awards were made to scouts participating. Tree seedlings, furnished by the North Dakota Game and Fish Commission and the Soil Conservation Service, were machine planted during the operation. Planting success has been excellent and many larger trees brought from home and nearby areas were also transplanted on the reservation. In 1958, "Operation Tree Care," in addition to another program of planting, assures the success of the program. Scouts participating in the conservation phase were awarded a "patch" emblem to identify and recognize their important contribution in the development of the area. The central service lodge is also to be constructed next year. This will be a fine brick building to house service facilities for patrol groups encamped in outlying areas.

The year 1957 was one of considerable progress in the Scout council's activities. Under the leadership of Charles Conrad, Great Plains Council President, and Rudy G. Peterson, Scout executive, the summer encampment at the Heart Butte Scout Reservation and development of the site were highly successful.

Boy Scouts and their leaders are enthused about their new summer encampment program. In the sheltered bay areas water-safety programs go forward under ideal conditions. It is ideal for canoes, and shallow beach areas provide an excellent location for swimming lessons. Heart Butte, being one of the best fishing lakes in the State, gives the Scout a chance to prove he is "smarter than the fish." Hiking, nature trails, the council fire, and many other forms of recreation and relaxation in the "open air of the country" are well afforded here. This is typical shortgrass country—occasionally, scouts find arrowheads, bone knives, or other remains of the American Indians in their treks over the adjacent prairies.

Each troop at summer encampment will have its own shelter area where cookouts and meetings can be held. Scouts bring their own tents and camping gear, and spend a week at "home on the range"—a pleasant excursion in outdoor living with partners and leaders of the Great Plains Council Scout movement.

Life in Scout camp is a busy one for these youngsters. Counselers meet each night to develop the following day's program for their individual troop and to coordinate their plans. Each troop usually plans 3 hours activity for each morning and afternoon. Troop plans and activities are coordinated to include swimming, canoeing, hiking, archery, compass work, boating, rope tying, learning the use of tools, games, fishing, as well as cleanup, sanitation, and varied ac-

Missouri Valley Boy Scout encampment at Heart Butte offers archery practice.

tivities of the camp. Prizes are awarded for troopwork, and each troop tries to win honors on camp inspection. In twilight hours the entire camp assembles to sing, put on skits, get a good campfire going, and enjoy the fellowship afforded by the summer encampment. Once each week an honorary ceremonial "Order of the Arrow" is staged where tribute is paid to a member selected from each troop. The ceremony begins by a flaming arrow shot from behind a hill near the council grounds, and is an impressive moment for each Scout in his tour of encampment. As the Scout leaves, he has learned many things about outdoor living, and in the association of others of his age. Probably he has learned to swim, how to handle a canoe, use a bow and arrow, the importance of conservation of our resources, and many things

General assembly of Boy Scouts of Missouri Valley Council.

that only scouting and camp life bring out. A week at camp has provided him invaluable lessons in good citizenship.

These splendid opportunities provided to the youth of the council area for summer encampment are well founded. The leaders of this council look forward to the continued growth in summer encampment.

As Heart Butte Scout Reservation Camp continues to grow, these fine facilities and enjoyable moments of camping and outdoor living for the boys will contribute much to the time-honored motto of every Scout: "Be prepared." The dividends from their investment will accrue manyfold, and they are to be commended for their work in this important task of building and molding youth—our leaders of the future. ###

HOW ABOUT CASTORBEANS?

Experience has shown that castorbeans can be grown successfully on a commercial basis and can compete effectively for land with other crops, when yields and price relationships are favorable.

Domestic bean prices have been relatively high, and worldwide demand for castor oil is rising to fill industrial and defense needs.

Demand in the United States has been generally strong in recent years, and imports of castorbeans and castor oil are large. A large United States crop, therefore, would make this country less dependent upon imports of crops particularly important in times of international tension.

In the first place, castor oil and its derivatives are used as a raw material in the manufacture of many materials needed for military and defense production, as well as for other products in everyday use.

It is the starting material in the manufacture of sebacic acid, used in making synthetic lubricants for jet aircraft, plastics, and nylon bristle. It is also used in the manufacture of all-purpose greases, hydraulic fluids, artificial leather, pharmaceuticals, soap, printing ink, special low-temperature lubricants, and flexible coatings, as well as plasticizers which are used in the manufacture of explosives and fabrics.

Largest single consumer is the protective-coating industry. Dehydrated castor oil is used as a quick-drying base for paints, lacquers, and varnishes.

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Sesame—AN ANCIENT CROP WITH A FUTURE

by G. W. RIVERS and M. L. KINMAN [1]

Available literature on sesame, *Sesamum indicum* L., indicates that this plant is one of the oldest of the cultivated annual oil seed crops grown by man. Sesame was first grown by small farmers in Asia and Africa. It was brought from Africa by Negro slaves to the Southeastern United States in the 17th century. Since these early importations, sesame has slowly established itself as a crop in the South. In the last 4 or 5 years sesame has become a valuable cash crop in Texas and to some extent in other Southern States and in California and New Mexico. In recent years a rather large commercial acreage has developed in South America. The acceptance of sesame as a crop has been brought about by the research and educational programs of Federal and State agencies working jointly on this planned project. If normal progress is made in this joint endeavor, it would seem reasonable to assume that sesame will become an important cash crop in the South.

Adaptability

Sesame is best adapted to the southern half of the United States where high temperature prevails during the growing season. Sesame is not adapted to soils of low fertility and this is borne out by the fact that best yields are obtained on fertile, well-drained soils. Sesame appears well adapted to most of the more fertile soils of Texas, with the possible exception of the northern part of the Panhandle where early frosts occur, and the high rainfall areas of east Texas where leaf diseases may hinder production. Soils with neutral reaction are preferred, but good results have been obtained on either slightly acid or slightly alkaline soils. Moderate applications of commercial fertilizers are required for satisfactory production on soils of low to moderate fertility.

The plant is somewhat drought resistant and has been grown for centuries in the Middle East with little or no rainfall during the growing season, depending solely upon stored moisture from the rainy season. Areas receiving adequate rainfall for the production of dryland cotton or sorghum have enough moisture for the production of sesame. The highest yields of sesame reported in the United States have been from experiments ground under irrigation in desert areas, with slightly less irrigation water than is required for maximum yields of cotton. Excellent yields have been obtained from as little as 18 inches of irrigation water in the Salt River Valley of Arizona.

Cultural Practices

Sesame should not be planted until the danger of low temperatures is past. Planting dates may be as early as March 20 in the southern limit of the area of adaptation, and as late as June at the northern limit. Generally, sesame would be planted shortly after cotton or sorghum in areas where these crops are grown. June plantings have proved satisfactory in areas with long growing seasons and adequate moisture.

One pound of sesame containing about 150,000 seeds is normally adequate to plant an acre. However, if thinning is practiced, up to 4 pounds per acre may be used. Seed should be planted three-fourths to 1½ inches deep in a well-prepared seedbed that is weed free, mellow, and moist. The depth of planting will depend on the soil texture and available moisture at planting time. It is usually necessary to plant slightly deeper in a fast drying clay textured soil than in a sandy soil.

In humid areas and in irrigated sections, satisfactory results have been obtained by planting on

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Sesame growing at breeding nursery at College Station, Tex., where hundreds of strains, selections, and hybrids are tested.

slightly raised beds. In drier areas, planting on level beds or in shallow furrows has been satisfactory. Presently most of the sesame is grown in rows 36 or 40 inches apart. Double rows 12 to 16 inches apart on 36- to 40-inch vegetable beds have proved satisfactory under irrigation.

Experiments have shown that increased yields of seed have been obtained with 20-inch as compared to 40-inch rows. Thinning is not recommended if the plants are not closer than 1 inch apart in the drill. Available information indicates that stand tolerance is high, under some conditions at least, and a uniform stand of about 40,000 plants per acre may produce as great a yield as approximately four times this number of plants per acre. Methods of seedbed preparation, row spacing, and the stand required for highest production will depend on local environmental conditions, growth habit of the variety and the equipment available. With minor adjustments, farm machinery used for cotton and sorghum can be adapted to planting and cultivating sesame. The major adjustment in machinery used for planting sesame is in the planter box. Sesame seeds are small and easily crushed and will clog the planter plates. The most satisfactory means of overcoming this difficulty is to replace the regular planter hoppers with vegetable planting equipment, such as "Planet Junior" hoppers.

Planting in a weed-free seedbed and early cultivation close to the plants is recommended. Early cultivation causes the seedlings to grow faster, possibly because of the improved soil aeration. When the seedlings become established and reach a height of 3 or 4 inches, they grow rapidly and very little additional cultivation is required to control weeds.

With current shattering varieties such as the K–10 types, much of the hand labor in harvesting can be eliminated. A row binder, such as that used in harvesting corn or sorghum, may be used for cutting and binding the taller type of sesame. A small grain binder, like that used for harvesting wheat and oats, works very satisfactorily for the shorter varieties. Plants are cut and tied in small bundles. The seed ripens and the leaves fall from the plant while the stems are still green and appear immature to the inexperienced grower. Harvesting immediately after the leaves fall prevents some loss from shattering. The bundles are shocked in small shocks consisting of 8 to 10 bundles, and a string is tied around the top of the shock to prevent it from blowing over in the event of a rain or wind storm. In about 2 weeks, under sunny conditions, the bundles are dry enough to thresh.

A grain combine is preferred to the stationary thresher since the only handwork required is to pick up the bundles and throw them into the combine. The combine is pulled from shock to shock. With careful handling of the bundles, 95 percent or more of the seed may be saved.

The cultural practices mentioned above for the shattering varieties of sesame apply to the nonshattering varieties, with the exception of harvesting. When the nonshattering varieties reach physiological maturity, the plants are cut and windrowed. When the plants are dry, they can be threshed with presently available combines. In order to prevent excessive cracking of the seed the cylinder speed of the combine must not exceed 500, 580, and 700 r. p. m. for cylinder diameters of 21, 18, and 15 inches, respectively. To compensate for the slower cylinder speed, the threshing sur-

Nonshattering-type sesame capsule on left, shattering type and exposed seed on right.

face must be increased to approximately double that used for small grains by increasing the number of cylinder or concave bars or both in order to obtain high threshing efficiency.

Non-Shattering Sesame

Indehiscent or nonshattering sesame, that does not lose its seed upon drying, occupies only a small part of the present commercial acreage being grown in the United States. An important phase of the cooperative Federal-State breeding program is devoted to the development of nonshattering varieties. The increase of sesame acreage in the United States depends on the development of nonshattering varieties adapted to complete mechanization, which will produce comparable yields with the present shattering varieties. Indehiscent varieties are now available and the mechanization problems have been worked out reasonably well. When better nonshattering

Desirable Delco—large strain of sesame capsule on left and Rio-short strain on right.

varieties are obtained and properly modified harvest machinery is generally available, it is believed that domestically produced sesame will be competitive with other oilseeds. This problem is a joint one involving plant breeding and agricultural engineering.

Uses

The baking industry is the principal market for whole sesame seed in the United States. A large percentage of the seed is used as a topping for bread and rolls and is the form most familiar to the American public. The whole seed is also used in a wide variety of confections. The oil, which is pressed from the seed, is used for shortenings, cooking oils, margarine, and in soaps, drugs, cosmetics, and insecticides.

Experimental field of nonshattering sesame.

Sesame oil possesses a mild pleasant flavor and is easily processed and refined. In Latin America, it is considered the "Queen" of all vegetable oils. Perhaps the outstanding characteristic of sesame oil is its stability or keeping quality, which is a result of its resistance to oxidative rancidity. Sesame meal, the residue remaining after oil extraction, is a valuable protein supplement for livestock and has possibilities as human food.

Market

The specialty uses to which sesame seed are essential in the United States are gradually increasing and imports appear less reliable than previously. This should allow some expansion of production of shattering-type varieties best suited

Combining from windrow with pickup attachment.

to these uses. However, if large acreages of sesame are grown in the United States, the seed must enter the oilseed processing trade. Industrial acceptance of the oil seems assured whenever sufficient quantities are regularly available at prices comparable with competing vegetable oils. Complete mechanization (of nonshattering varieties) is probably required for such a price structure to exist.

Commercial concerns interested in sesame marketing or processing sesame seed contract for the desired acreage before the planting season; supervise the growing of the crop, and either purchase or arrange for sale of the seed at harvest time.

Shattering-type sesame harvested with special rig. Yield was 780 pounds seed per acre.

The Future

Sesame is still a young commercial crop in this country, no regular grain trade channels have been established. Before a farmer plants a crop, he should make sure he has a market for his crop. Although some sesame is sold on the open market at harvest time, much more is contracted before the crop is planted.

Farmers who have grown sesame and given it equal care with their other cash crops have made money. With new nonshattering varieties, the future appears even brighter. It should be pointed out again, as has been done in the past, that sesame is not a wonder crop, but requires careful, intelligent production methods. With increased research and grower experience, sesame should become a stable crop in the South. ###

Corrosion

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them may prove to be the finest and cheapest type of maintenance but the choice of the proper coating requires careful study.

There is another method of controlling the corrosion due to electrolysis of buried and submerged metal known as cathodic protection, which is coming rapidly into use both in this country and in many foreign countries. Such corrosion is caused by minute electric currents carrying metal from one area called the anode toward another area known as the cathode. Cathodic protection is a process in which very low induced currents are caused to flow toward all parts of the surface to be protected. The process known as galvanizing whereby a metal surface is coated with zinc is an example of cathodic action.

The induced current is produced by an external source, such as a rectifier, or by using such metal anodes as magnesium, zinc, or aluminum to form a galvanic cell with the metal to be protected.

Under ordinary conditions one ampere will protect more than 1,000 square feet of bare metal at an annual cost of $10 to $20.

The Bureau of Reclamation has been doing some pioneer work toward applying cathodic protection to irrigation structures such as radial gates in checks and wasteways, steel pipe siphons and the silt clarifiers at Imperial Dam. The results secured have been quite satisfactory and in some instances the savings made have been unusually high.

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Land leveling prior to irrigation.

Crow Creek

Continued from page 62

the lands be brought under assessment for water immediately and that others be withheld until development work could be completed. The Irrigation District Commission granted these requests. As a result, in 1957, 2,833 acres received water and were assessed; and, in 1958, 3,300 will receive water and be assessed. By 1961, the full 4,247 acres now in the district will receive water and be assessed water charges. It is anticipated that an additional 260 acres will petition this year for admission into the district.

The Crow Creek Unit has sold itself to the landowners in the area, tripling its acreage in about 3 years' time.

Various reasons have been advanced for the increased interest in irrigation, but the most obvious one is that in the face of recent dryland crop failure and near failures, irrigated unit lands have produced crops of up to 5 tons of alfalfa hay per acre and up to 30 bushels of peas to the acre.

Crow Creek farm operators are spending up to $130 per acre in some cases for land leveling and irrigation development. Such expenditures have proved economically sound, for 1 man can irrigate about 25 such acres in a day, 3 times the usual rate in Montana.

In general, the land on the unit has an adequate phosphate content but is low in nitrogen and organic matter. In places where heavy cuts have

Grain crop almost hides Bill Thompson.

Attractive homesite on Crow Creek Unit.


Bill Thompson and Harry Stanley, watermaster, speculate on yield.


Plowing in contour ditches preparatory to harvest.

been made to level the land, applications of up to 300 pounds of nitrogen and phosphate mixed appear to be necessary. Experience has shown that if such fields are planted to alfalfa hay, the leveling is apparent the first year but not the second year. Farmers feel that after the third year of cropping to alfalfa, the land will be suitable for any type of irrigated agriculture.

One of the extremely favorably signs on the Crow Creek Unit is the manner in which farm operators are handling the transition from dry to irrigated farming methods. For the most part, operators are placing their acreages under the agricultural conservation program. They are applying engineering and sound land treatment practices and, in general recognizing that irrigated agriculture demands techniques different from those practiced on dryland farms. This trend is being assisted considerably by the fact that in several instances successful irrigation farmers from other parts of the West have been attracted to and purchased land on the unit.

Alfalfa on Hunsacker Farm yields up to 5 tons per acre.

Alfalfa ready for second cutting.

ASCE Plaques

Continued from page 64

Water and Power, Hoover Dam, and D. D. Dutter, resident engineer for Southern California Edison Co.

L. F. Wylie, construction engineer for the Bureau of Reclamation at Glen Canyon Dam and Al Bacon, construction superintendent for Merritt-Chapman & Scott, prime contractor on Glen Canyon Dam, flew down from Kanab, Utah, to witness the unveiling.

The bronze plaque, mounted on the upstream parapet wall, reads "A Modern Civil Engineering Wonder of the United States—One of the Seven Selected by the American Society of Civil Engineers—1955." The lettering surrounds a miniature blue and gold ASCE shield.

The other "Wonders" include the Colorado River Aqueduct, the Panama Canal, the San Francisco-Oakland Bay Bridge, the Empire State Building, and Chicago's Sewage Disposal System. The seven were selected from among several hundred other civil engineering works nominated by ASCE members.

GRAND COULEE DAM AND THE COLUMBIA BASIN PROJECT

"Grand Coulee Dam and the Columbia Basin Project—an Engineering Marvel!"

That is the citation made by the American Society of Civil Engineers in naming the Columbia Basin project as one of the "Seven Modern Civil Engineering Wonders of the United States."

Against backdrop of Grand Coulee Dam, plaque awaits unveiling.

P. R. Nalder, CBP Manager, presents ASCE President Howson picture album of project.

President Howson, of the society, presented a plaque to Columbia Basin Project Manager Phil Nalder, formally dedicating the citation at a special ceremony at Grand Coulee Dam on March 11, 1958.

In presenting the plaque, Mr. Howson paid particular tribute to the many engineers who had worked and who are still working on the project when he told the audience, "The project is a monument to the creative imagination of the modern civil engineer who first had the constructive vision to recognize the potentialities of such a project and the planning abilities to draw together the tremendous resources and power exercised in the development.

"This project has now been in operation long enough to demonstrate many of its contributions toward human welfare. It has materially affected the economic life and development of the entire Pacific Northwest to such an extent that it has been the forerunner of additional great power expansion, both public and private.

"The Columbia Basin project harnessed nature to meet man's needs on a scale so tremendous that it was long considered completely visionary and impossible. The execution of the project was largely the result of the application of civil engineering principles with broad vision and ingenuity.

"This selection of Grand Coulee Dam and the Columbia Basin project as "One of the Seven Modern Civil Engineering Wonders of the United States and the presentation of this plaque are concrete indications of the workings of the civil engineering profession for the benefit of mankind."

In accepting the plaque on behalf of the Bureau of Reclamation, Phil Nalder, Columbia Basin project manager, honored all who have worked to make the Columbia Basin project a success when he said, "To us this plaque is more than a recognition of the engineering accomplishments on the project. It is a tribute to the thousands of employees who have worked and those employees who are now working to make it a success. It is also a memorial to those who were associated with this project but did not live to witness this honor."

Work was started on this irrigation project over 24 years ago when the late Frank A. Banks drove the stakes for the axis of Grand Coulee Dam. Construction has been going on continuously since that time. The last 108,000-kilowatt generator was placed in the powerplant in late 1951 and the plant has maintained maximum production since. Last year 2½ percent of the Nation's electrical energy and approximately 40 percent of the energy in the Pacific Northwest was generated here. A part of the energy produced is used to operate the world's largest irrigation pumps necessary to lift the water from Franklin D. Roosevelt Lake 280 feet into the grand coulee where it flows by gravity to the irrigation project some 60 miles south. Crops worth \$24½ million were grown on 203,000 acres in 1957.

CBP Design Chief Davidson looks on as Project Manager Nalder accepts plaque from ASCE President Howson on behalf of Bureau of Reclamation. Louis Rydell, ASCE Director, and Edwin Nasburg, CBP Hydrology Chief, to the right.

To June of last year, approximately \$517 million was spent on the project. To complete it, at today's prices, it is estimated it will cost \$250 million. Regardless of the cost of the project, hovewer, the entire amount expended will be repaid to the United States Treasury with income from the sale of power and the portion of construction costs assessed the water users. In addition, a 3-percent interest payment is being made on expenditures for power facilities. It is interesting to note that through last June, \$139 million had been returned from project operations to the Treasury.

To completely describe the many engineering features to be found on the project would take pages, but, as can be attested by the number of persons who visit with us from all walks of life each year, it may well be stated that it is one of the most interesting developments of its kind in the world.

Do You Know . . . Irrigation Water Isn't All Wet

Are the ditches that bring water to your farm free of weeds? If they are not, when you irrigate you will be adding something more than water to your fields. A curious research worker in Colorado took the trouble to count the weed seeds carried in the water by a weedy ditch. His finding was startling—an application of 6 inches of water per acre carried with it 170,800 weed seeds! This is one reason why crops must be cultivated, or sprays like 2, 4D used, to keep yields up.

Subscriptions

Subscription rates for the quarterly publication are 50 cents per year, with 15 cents additional required for foreign mailing. Separate copies may be purchased for 15 cents each.

All subscriptions should be sent direct to the Superintendent of Documents, Government Printing Office, Washington 25, D. C. Requests for changes in mailing address, renewals, and separate copies should also be sent direct to that agency. #

Castorbeans

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An estimated 135 million pounds of castor oil were utilized in manufacturing processes in 1957, while only about 9.5 million pounds were produced from domestic beans. This meant that United States industry met its needs chiefly from imports.

This country, in fact, takes about 50 percent of the total world trade in castorbeans and oil. This year, prospects are that domestic castorbean acreage will be larger than in 1957, but even the larger output will represent only a relatively small portion of the United States industry's requirements.

In 1957, domestic growers harvested about 15,500 acres, according to trade estimates. These produced about 21 million pounds of beans, compared with 4 million in 1956. Practically all the beans were grown under irrigation, with California accounting for over half of the United States output.

The sharp increase reflects mainly the availability of acceptable harvesters and favorable prices. The average per-acre yield in 1957 was 1,360 pounds, compared with 780 pounds a year earlier. Yields in individual States varied from 1,825 pounds per acre in California, to 300 pounds in the dryland areas of Oklahoma and Arkansas. increase. Also, castorbeans are poisonous and must not be fed to animals or consumed by humans.

Castorbeans store well. Some varieties can be held as long as 5 years without significant loss of oil content. This could go a long way toward giving the market some stability in supply and in moderating the sharp price fluctuations.

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MAJOR RECENT CONTRACT AWARDS

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DC-4978	Ventura River, Calif.	June 11	Construction of steel tanks for Oak View, Villanova, Ojai East, Upper Ojai, and Rincon reservoirs.	Chicago Bridge and Iron Co., South Pasadena, Calif.	$884,576
DC-4979	do	May 9	Construction of Ventura Ave., Ojai Valley, Upper Ojai, and Rincon pumping plants.	Robert E. Ziebarth and Sylvester B. Alper, Torrance, Calif.	546,213
DS-5001	Missouri River Basin, N. Dak.	Apr. 28	One 25,000-kva synchronous condenser with control equipment for Fargo substation.	Allis-Chalmers Mfg. Co., Denver, Colo.	372,577
DC-5021	Fort Peck and Missouri River Basin, Mont.-N. Dak.	May 14	Constructing foundations and furnishing and erecting steel towers for 310 miles of Fort Peck-Dawson County-Bismarck 230-kv transmission line.	Lipsett, Inc., Sioux Falls, S. Dak.	5,275,510
DC-5022	Wapinitia, Oreg.	May 26	Construction of Wasco Dam	C. H. Strong Engineering & Construction, Eugene, Oreg.	231,270
DS-5023	Colorado River Storage, Ariz.-Utah.	Apr. 3	3 million barrels of bulk portland cement for construction of Glen Canyon Dam and powerplant.	American Cement Corp., Los Angeles, Calif.	9,741,900
DS-5024	Missouri River Basin, N. Dak.	Apr. 24	Two 230-kv power circuit breakers for Fargo substation	Brown Boveri Corp., New York, N. Y.	131,825
DC-5028	Weber Basin, Utah	May 8	Construction of earthwork, pipelines, and structures for Uintah Bench laterals, Weber aqueduct lateral system.	Hilton and Carr Construction Co., Ogden, Utah.	983,662
DC-5032	do	June 12	Construction of first stage earthwork, extension of drainage in borrow area A, and placing excavated material in dam embankment, Willard Dam.	M. H. Hasler Construction Co. and H. C. Smith Construction Co., Los Angeles, Calif.	1,101,140
DC-5039	Missouri River Basin, Kans.	do	Construction of earthwork and structures for Courtland canal laterals, wasteway, and drains.	Bushman Construction Co., St. Joseph, Mo.	391,801
DC-5045	Colorado River Storage, Utah-Wyo.	June 18	Construction of Flaming Gorge Dam, powerplant, and access roads.	The Arch Dam Constructors (Joint venture of Peter Kiewit Sons' Co., Morrison-Knudsen Co., Inc., Mid-Valley Utility Constructors, Inc., Coker Construction, Inc.) Omaha, Nebr.	29,602,497
117C-512	Columbia Basin, Wash.	June 16	Construction of five 2-bedroom residences with attached garages, office, and 5 service buildings; and roads and utility systems for Wahluke headquarters site.	Basin Builders, Ephrata, Wash.	163,400
200C-369 Supp.	Ventura River, Calif.	do	Clearing Casitas reservoir site	Union Construction Co. and R. A. Bianchi Construction Co., Ventura, Calif.	348,488
400S-100	Colorado River Storage, Ariz.-Utah.	May 19	Power for construction of Flaming Gorge Dam and powerplant.	Moon Lake Electric Association, Vernal, Utah.	1,213,800
400C-107	Weber Basin, Utah	Apr. 29	Construction of 2.3 miles of access roads, parking areas, concrete boat ramp, recreational facilities, and water supply system for Wanship reservoir recreation area.	Nelson Brothers Construction Co., Salt Lake City, Utah.	134,244

MAJOR RECENT CONTRACT AWARDS—Continued

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DC-5044	Rogue River Basin, Oreg.	June 25	Enlargement of Emigrant Dam	R. A. Heintz Construction Co., Portland, Oreg.	$2,635,493
DS-5049	Central Valley, Calif.	June 30	Penstock header and outlet pipe for Trinity Dam	Southwest Welding and Mfg. Co., Alhambra, Calif.	2,313,953
DS-5053	Colorado River Storage, Ariz.-Utah.	June 30	220,000 tons of pozzolan for Glen Canyon Dam and powerplant	J. G. Shotwell, Mercer Island, Wash.	2,508,000
DC-5056	Colorado River Storage, Colo.-N. Mex.	June 25	Construction of Navajo Dam and access roads	Morrison-Knudsen Co., Inc., Henry J. Kaiser Co., F and S Contracting Co., Los Angeles, Calif.	22,822,624
DC-5061	Rogue River Basin, Oreg.	June 30	Construction of earthwork and structures for Conde Creek and Dead Indian collection canals; and two diversion dams.	Cherf Brothers, Inc., Sandkay Contractors, Inc., Cheney Construction Co., S. Birch and Sons Construction Co., Ephrata, Wash.	165,579

Construction and Materials for Which Bids Will Be Requested Through September 1958*

Project	Description of work or material
Boulder Canyon, Ariz.-Nev.	One 115,000-hp, 180-rpm, 480-foot-head, vertical-shaft, Francis-type turbine for Unit N-8, Hoover powerplant.
Central Valley, Calif.	Clearing timber and brush from Stuarts Fork of the Trinity Reservoir area, near Lewiston.
Do	Relocating 9 miles of county road from Rush Creek to Mule Creek, about 60 miles northwest of Redding.
Colorado River Storage, Ariz.	Constructing a 48- by 256-foot administration building, a 96- by 48-foot, 1-story police building, a 40- by 100-foot steel frame fire station, and a 40- by 100-foot steel frame garage building. At Page, about 135 miles north of Flagstaff.
Do	Embedded metalwork for four 40-foot 0-inch by 52-foot 6-inch radial gates at Glen Canyon Dam. Estimated weight: 95,500 pounds.
Columbia Basin, Wash.	Earthwork and structures for about 2.8 miles of 36-foot bottom unlined canal and about 1.1 miles of 12-foot bottom width concrete-lined canal. Wahluke Canal, near Othello.
Do	Earthwork and structures for about 60 miles of unlined laterals, wasteways, and drains with bottom widths varying from 14 to 2 feet near Vantage.
Do	Earthwork and structures for about 23 miles of open and closed drains near Othello, Moses Lake, and Quincy.
Do	Gravel surfacing about 10.3 miles of operating roads west of Mesa.
Do	Four synchronous, motor-driven, horizontal, centrifugal-type pumping units, 3 with a capacity of 51 cfs at a total head of 65 feet, and one with a capacity of 25 cfs at a total head of 65 feet for the Sand Hollow pumping plant.
Crooked River, Oreg.	Constructing the 188-foot-high earth and rockfill Prineville Dam, containing about 1,400,000 cubic yards of material and having a crest length of 790 feet. On the Crooked River, about 21 miles southeast of Prineville.
Eden, Wyo.	Earthwork and structures for about 10.5 miles of surface drains, 0.5 mile of deep drain, and rehabilitating 1 mile of existing lateral, about 42 miles north of Rock Springs.
Fort Peck, Mont.	Three single-phase, 220-115-13.2-kv, 20,000/20,000/10,000-kva autotransformers with provisions for 2 stages of future forced air cooling, and 3 each 97- and 15-kv tank-mounted lightning arresters for the Dawson County substation.
Do	Two 3-phase, 230-kv, 1,200-ampere, 5,000-mva interrupting rating power circuit breakers and two 3-phase, 115-kv, 800-ampere, 1,500-mva interrupting rating power circuit breakers for the Dawson County substation.
Little Wood River, Idaho.	Clearing trees, brush, and other floatable debris from about 73 acres of the Little Wood River Reservoir area, about 12 miles northwest of Carey.
Middle Rio Grande, N. Mex.	Clearing, cleaning, and shaping about 35 miles of open ditch laterals, removing existing structures, and constructing new structures near Belen and Albuquerque.
Do	Clearing and excavating about 1.1 miles of pilot channel in the Rio Grande to a 150-foot bottom width, and furnishing and erecting a jetty field. Hot Springs area, near Truth or Consequences.
Middle Rio Grande, N. Mex.—Con.	Constructing about 5 miles of 14-foot bottom width canal, excavating about 1 mile of 150-foot-wide pilot channel, removing a brush diversion weir, installing metal jetty units, and constructing structures. San Juan Feeder Canal, near Belen.
MRB, Minn.	Granite Falls substation additions including concrete foundations, furnishing and erecting steel structures, and installing a 115/69-kv, 25,000-kva transformer, associated circuit breakers, and other electrical equipment.
MRB, Mont.	Earthwork and structures for about 11.5 miles of unlined laterals with bottom widths of from 5 to 3 feet. Spokane Bench Laterals, near Helena.
MRB, Nebr.	Constructing a 38 by 40 foot concrete block headquarters and office building complete with water supply, sewerage, heating, and electrical systems. At Red Cloud.
Do	Constructing a 43 by 120-foot concrete block headquarters and shop building complete with water supply, sewerage, heating, and electrical systems. At Cambridge.
MRB, Wyo.	Grading and gravel surfacing about 5 miles of county road, grading and bituminous surfacing, with a crushed rock base, about 1 mile of access road and a parking area at Glendo Dam, about 5 miles southeast of Glendo.
Do	Clearing about 52 acres of timber and brush from the Anchor Reservoir area, about 39 miles west of Thermopolis.
Provo River, Utah.	Constructing the riprap faced Stewart Park Dike, about 4,355 feet long, on the Provo River, about 21 miles northeast of Heber.
Do	Installing a radial gate in intake structure to Duchesne Tunnel, constructing a telephone line from outlet to inlet of tunnel, and 4 miles of gravel surface access road, near Kamas.
Rogue River Basin, Oreg.	Constructing the concrete Ashland Diversion Dam, 8.5 feet high with overflow crest 65 feet long, an earthfill dike extension, concrete canal headworks structure, and about 3 miles of open ditch lateral, 1.5 miles of which are to be concrete lined, near Ashland.
Do	Constructing a 2-bedroom frame residence and garage at Green Springs powerplant, about 11 miles southeast of Ashland.
Weber Basin, Utah.	Constructing 8 rectangular, earthlined reservoirs each to be 22 feet from bottom of reservoir to top of banks, 6 of which are to have 20 acre-feet capacities and 2 which are to have 12 acre-feet capacities. Work will also include construction of reinforced concrete control structures and pipeline connections to the Davis Aqueduct, near Salt Lake City.
Do	Earthwork and structures for about 3.9 miles of 15- to 21-inch precast concrete pipelines and 9.8 miles of unlined open ditch laterals with bottom widths of from 4 to 2 feet. West Farmington area, near Salt Lake City.

*Subject to change.

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The Reclamation Era

NOVEMBER 1958

IN THIS ISSUE:

SALINE WATER, by Fred G. Aandahl, Assistant Secretary of the Interior

Official Publication of the Bureau of Reclamation

The Reclamation Era

NOVEMBER 1958 Volume 44 No. 4

In this issue . . .

J. J. McCARTHY, Editor

T. R. McCANN, Art Director

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Beef Cattle On The Strawberry Valley Project

Roundup time on the Strawberry Valley summer range.

Production of beef cattle is an important item and is closely integrated with the farming practices and the total economy of the Strawberry Valley Project. Raising beef cattle requires an understanding of physical and economic conditions as they affect each individual's enterprise including the many contributing factors which are beyond the control of each operator. Market trends are studied to determine how many cattle it will be desirable to hold or to purchase. The amount of feed raised, the amount of feed available on pastures, and the amount of feed that can be purchased in relation to anticipated profits from sales also influence the number to be fed. Project farmers who raise or feed cattle plan farming operations to coordinate the needed forage crops with cash crops. Alfalfa and other hay, field corn, and grains are the crops raised principally for feeding. Such crops as sugar beets, peas, and sweet corn are raised as needed cash crops as well as feed to supplement forage crops.

Crops raised on the Strawberry Valley Project are conducive to the raising and feeding of livestock. Of approximately 37,000 acres of irrigated lands, about 18,300 are used to raise alfalfa and other hay, pastures, and corn ansilage principally for the feeding of livestock; 12,300 acres are used to raise barley, oats, wheat, and grain corn, much of which is fed to livestock; and 4,000 acres of sugar beets, sweet corn, and peas which also provide some forage. There are only about 2,400 acres of orchards and other canning crops which do not contribute to the livestock industry.

by W. HAROLD HIRST, Conservationist, Region 4, Bureau of Reclamation

In addition to crops raised on the irrigated farm lands, the cattle enterprise of the project is materially benefitted by 57,000 acres in Strawberry Valley, of which all but 8,400 acres occupied by the Strawberry Reservoir, where project water is stored, are grazed during the summer by sheep and cattle owned by project farmers. This range does not provide summer grazing for all project livestock, but it has a great influence on the number raised and fed on farms or utilizing forage from those farms. As an indication of the numbers of livestock on the project, the crop census for 1951, the last year that a livestock inventory was taken, showed there were approximately 11,000 beef cattle; 39,000 sheep; 4,000 dairy cattle; 3,000 hogs; and 140,000 chickens.

Beef cattle operations vary from farm to farm. Some farmers maintain breeding herds and raise calves for sale as feeders or as fat cattle. Others purchase feeders entirely while still others maintain small breeding herds and purchase extra feeders.

During the summer, cattle are grazed on the Strawberry Valley range, on irrigated pastures, or on other available summer pasture. After cattle are returned to the farms, they are usually grazed on crop aftermath or pastures as long as feed is available, until bad weather precludes further grazing, or until a desirable price is obtained.

At the end of the grazing season, cattle to be fattened are placed in corrals or feed lots while those to be maintained over the winter are either placed in corrals or fed in the fields. Adequately constructed corrals and sheds are important to fattening cattle since exposure to cold and windy weather may make it impossible to obtain maximum gains. In fact, some feeders prefer to place cattle to be fattened on maintenance rations until the end of February when satisfactory gains are possible. Feed lots or corrals vary considerably, as can be noted in the accompanying photographs, but have the common qualities of well-drained or surfaced yards, an accessible manger, and protection from winds and inclement weather.

Once cattle are in the feed lot for fattening or in the corrals or fields for maintenance throughout the winter months, producers begin the utilization of the harvested crops and purchased supplements. Feeding practices vary considerably between farmers according to feeds available or through rations found to give the best results. There is also considerable difference in rations for the maintainance or for the fattening of livestock. The following examples illustrate the differences in rations and show the general feeding practices followed on the Strawberry Valley project.

George Chaffin raises some cattle but purchases most of them as feeders. He uses alfalfa and corn ensilage in his feeding operations. The ensilage, which he raises, consists principally of alfalfa and corn. This is placed next to an excavated hillside by dumping from trucks from above. The ensilage consists of about four-fifths alfalfa and one-fifth corn. He also harvests some of his alfalfa

Feed lot where George Chaffin fattens cattle. A few are kept on feed year long.

Feed yard of Arlo Larson and baled alfalfa hay ready for larger feeding operations after harvesting season.

and grass as dry baled hay. Maintenance rations usually consist of 30 pounds of dry hay per day per head with about two pounds of cottonseed cake or meal added when inferior hay is being fed. During the fattening process two rations are used, one is a starting ration and the other a finishing ration. The daily starting ration, which is fed only from about 10 to 16 days, consists of 4 to 5 pounds of rolled barley, 2 pounds of dry beet pulp, 2 pounds of cottonseed cake or meal, 4 to 5 pounds of dry hay, and as much ensilage as they will eat. The fattening ration is the same except for increasing rolled barley to 15 to 18 pounds per day. Increasing the barley reduces the amount of ensilage that the cattle will eat. The average gain in weight of the cattle on the fattening rations is about 2½ pounds per day except during January and February when it is difficult to make gains unless better than average weather prevails. The fattening process takes from 120 to 150 days.

Glen Cowan raises about all the livestock he feeds. His maintenance ration consists of about 5 pounds of dry alfalfa hay, 20 pounds of grass hay, and one pound of cottonseed cake. The hay is harvested dry and put in stacks loose. Starting rations for fattening feeders consist of 5 pounds of rolled barley, ½ pound of cottonseed meal, 20 pounds of corn ensilage, and 8 pounds of chopped dry alfalfa. Fattening rations consist of 12 to 15 pounds of rolled barley, one pound of cottonseed meal, 8 pounds of chopped alfalfa, and 10 pounds of corn ensilage. Average gain for the full period on feed is about 2.3 pounds per day. Feeding for fattening starts about October 1 and is completed in from 120 to 150 days.

Grover Johns feeds starting rations for about 60 days which consist of 5 pounds of rolled barley, 2 pounds of dry beet pulp, and all the dry alfalfa hay the cattle will eat. Fattening rations consist of 15 pounds of rolled barley, 2 pounds of cotttonseed meal, up to 2 pounds of dry beet pulp, and all the dry chopped alfalfa the cattle will eat which does not exceed 10 pounds per day. The rate of gain is from 1½ to 2 pounds per day. The feeding period lasts from 150 to 180 days.

Arlo Larson feeds all year, although he feeds less cattle during the harvesting season. Because of the poor gains during the months of January, February, and March, he frequently holds fall purchased feeder cattle on maintenance rations until after that time. Maintenance rations consist of 10 pounds of dry alfalfa hay, and all the pea silage they will eat which is about 20 pounds. Fattening rations consist of 3 to 4 pounds of dry alfalfa hay, 30 to 35 pounds of corn ensilage, and about 15 pounds of rolled barley in the winter and about 12 in the summer. Fattening rations are fed for about 150 days. The daily rate of gain is less than 2 pounds during the winter and slightly more than 2 pounds during the spring, summer, and fall months.

Irrigated valley below Echo dam along Weber River. Scattered alfalfa hay stacks.

Feed lot and alfalfa hay ready for the feeding operations of Grover Johns.

Earl Levanger and Paul Lambert buy all their cattle as feeders. They are put directly on fattening rations which consist of 15 pounds of rolled barley, 4½ pounds of alfalfa hay, and 2 pounds of dried beet pulp. The feeding period is from 150 to 160 days and the rate of gain is from 1½ to 2 pounds per day.

Cattle raising and feeding, like any other business undertaking, is a matter of individual choice and, as in any other industry, the extent of profits varies among individual operators and depend on economic factors and individual enterprise. One common advantage in raising cattle, however, is being able to dispose of feed crops through the sale of fed cattle for which there is always a ready market. There is also the advantage of keeping fertility on the farm. Also the pride of ownership and watching efforts result in better herds and fattened beef is often satisfying and provides some compensation in addition to cash received from their sale. The exact magnitude of the benefits derived from cattle raising and feeding on the Strawberry Valley Project are not available but profits derived from this enterprise as a part of the farm activities add materially to project well-being, local economy, and American Agriculture. # # #

Ensilage harvested and ready for the feeding operations of George Chaffin.

ELMER F. BENNETT

New Under Secretary

Elmer F. Bennett of Longmont, Colorado, was nominated as Under Secretary of the Interior on September 21, 1958.

He came to the Department in 1953 as a Special Assistant to the Solicitor and Legislative Counsel. In these capacities he frequently appeared before Congressional Committees as a witness and technical adviser.

He became Assistant to the Secretary of the Interior in June 1956 and in this capacity he had assignments to assist in the formulation and development of policies and procedures throughout the complete range of Department activities. His duties also required that he maintain liaison with the several bureaus and offices of the Department, with the Congress, and other Government agencies.

He was promoted to the office of the Solicitor for the Department in May 1957. Prior to joining the Department he served as a trial attorney in the antimonopoly field for the Federal Trade Commission. He also served as legislative and legal adviser to the late Senator Eugene D. Millikin of Colorado.

Mr. Bennett was educated at Colorado State College of Education at Greeley, and Stanford University Law School at Palo Alto, California.

He is married to the former Gertrude Turner of Golden, Colorado. They have two children and reside in Bethesda, Maryland.

George W. Abbott, Assistant to the Secretary, of Grand Island, Nebraska, succeeds Mr. Bennett as Solicitor. # # #

CROP REPORT

The value of crop production on 77 Reclamation projects amounted to $928,156,918, and averaged $141.55 per acre in 1957. The cumulative value of crops grown stands at $13,277,660,991.

More than 150 important crops were grown on Reclamation projects. Specialty crops occupied only 16 percent of the acreage but produced 40 percent of the total crop value. For example, the grape harvest totaled $42.3 million, lettuce $30 million, and fresh market tomatoes $15.1 million. Melons added $18.7 million, carrots $10.4 million, and hops $15.9 million. Seeds, mint, and nuts accounted for $29.1, $3.6, and $5.5 million, respectively. Other specialty crops accounted for $201.1 million.

Irrigated lands on Reclamation projects did not contribute significantly to national crop surpluses. Tobacco, corn, wheat, and cotton accounted for about 86 percent of the value of all commodities under loan and in inventory of the Commodity Credit Corporation. None of the tobacco, less than one-third of 1 percent of the corn, 1.8 percent of wheat, and 2.4 percent of the cotton involved in the surplus program was grown on Reclamation projects.

Irrigated land provided full irrigation service totaled 3,319,425 acres. Supplemental water service was provided to 3,188,597 irrigated acres. Temporary water service was furnished for 49,244 irrigated acres.

The irrigated farms number 126,890, of which 80 percent are full-time operating units. These full-time farms provide support for 392,239 farm people. There are 94,136 people on part-time farms served by the Bureau.

Acreage and Gross Crop Value, 1957

Crop group	Irrigated crops		Gross crop value	
	Acres	Percent of total	Dollars	Percent of total
Cereals	1,710,143	26.08	112,404,817	12.11
Forage	2,987,263	45.56	115,517,940	16.76
Field crops, miscellaneous	1,151,674	17.56	278,901,066	30.05
Seeds	263,977	4.03	29,114,720	3.14
Vegetables	474,088	7.23	171,003,383	18.42
Fruits and nuts and miscellaneous	317,033	4.83	155,220,221	16.72
Other [1]			25,994,771	2.80
Total reported	6,904,178	105.29	928,156,918	100.00
Less: Multiple cropped	486,754	7.42		
Plus: Soil-building crops	20,845	.32		
Cropland not harvested	118,997	1.81		
Total	6,557,266	100.00	928,156,918	100.00

[1] Additional revenues from Federal and commercial agencies.

Four new units of the Missouri River Basin Project and 168,797 acres were added to the irrigation service area of Federal Reclamation projects in 1957, bringing the total area subject to irrigation service to 7,827,598 acres. The new units were Hanover-Bluff and Owl Creek in Wyoming, Sargent in Nebraska, and Kirwin in Kansas.

The area irrigated in 1957 was 6,577,266 acres, an increase of 157,123 acres over 1956.

Other major additions to irrigated acreage occurred on the following projects: Boulder Canyon, Colorado-Big Thompson, Columbia Basin, Gila, Minidoka and Rogue River Basin. The upward revision of the Colorado-Big Thompson project acreage is based on results of a complete survey of irrigated land under the project.

States gaining 5,000 or more acres of irrigated area in Reclamation projects were California, Colorado, Idaho, Nebraska, Washington, and Wyoming.

Grain and Forage Crops

Almost three-fourths of the irrigated acreage in Reclamation projects is devoted to the production of grain and forage, chiefly livestock feed crops. The livestock enterprises of these farms are of great significance to the rapidly growing population of the western states which heavily rely on this prime beef and lamb production. The center of the meat packing industry has been moving constantly westward. The hypothetical breaking point between eastbound and westbound livestock shipments is now near the eastern base of the Rocky Mountains. The intensified demand from coastal population centers will move this breaking point farther east as time goes on, adding emphasis to the need for finished meat production in the West. The grain and forage production on the irrigated lands of the West complements the grazing value of 700,000 acres of rangeland, making each more valuable to the cause of providing meat for the Nation's dinner tables. The acreage and production of these crops were slightly greater than in 1956. Their value amounted to $267,922,757, in 1957, approximately 29 percent of the value of all crop production.

Miscellaneous Field Crops

Miscellaneous field crops rank third in acreage but first in value among the several classes of crops. Their culture is less intensive and on a broader scale than that of vegetables. These crops include dry beans, cotton, sugar beets and other cash crops which are usually the pivot-point of a farmer's cropping rotation. Upon these is hinged a sequence of specialty and forage and feed grain crops. Western irrigated lands have natural production advantages for growing these crops, as evidenced by national acreage and production trends.

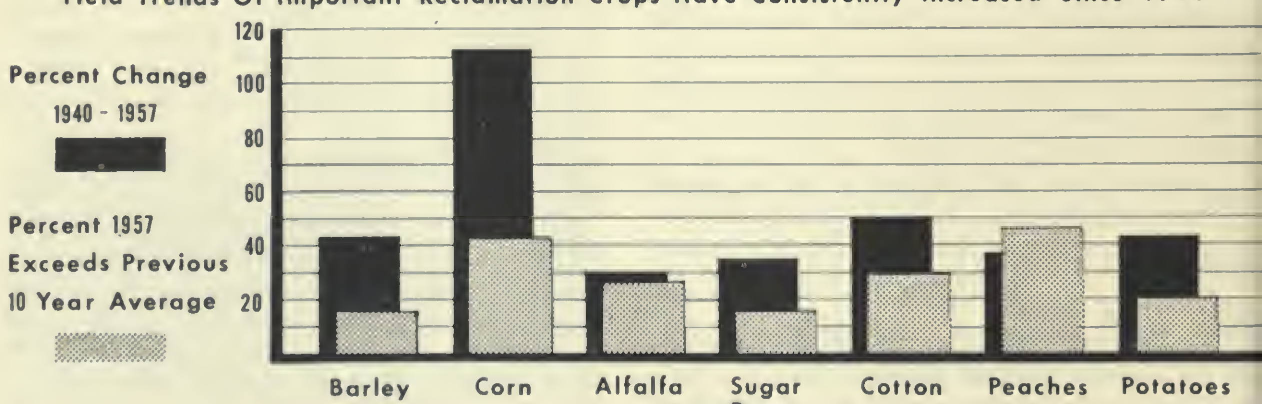
Probably the most universally grown cash crop on western irrigation projects is the sugar beet. Reclamation projects supply a little more than one-third of the sugar produced on the United States mainland. The average per acre yield of sugar beets exceeded the 1956 figure by 6 percent and was greater than the previous 10-year average by 16 percent. Since 1940 the per-acre yield on Reclamation projects has increased by 35 percent. The project-wide average yield on the Columbia Basin project was 25.2 tons per acre. Ten projects had sugar beet yields exceeding 20 tons per acre. Total returns for the crop, including the value of beet tops and additional factory and Federal payments was $91,312,122. Sugar beets on the Colorado-Big Thompson project alone had a total value of nearly $25 million.

Some of the specialty type crops in this category had significant changes in 1957. Castor bean acreage increased 10 times, broomcorn acreage increased 63 percent, and increases were also made in hops and mint acreage. Extra-long staple cotton, grown only in the Southwest under irrigation, more than doubled its acreage due to market demands and relaxation of acreage controls for this scarce, premium fiber crop. # # #

CREDIT

All photographs in the article entitled "Crow Creek is Growing Up," in the August issue of the Era were taken by Charles A. Knell, Region 6.

Yield Trends Of Important Reclamation Crops Have Consistently Increased Since 1940



New Cropping Methods On New Reclamation Projects

Lewis DeFillips irrigating sugar beets near Idaho Falls.

Photo by Stan Rasmussen, Region 1.

One of the outstanding and most significant agricultural developments in the United States during the post-World War II period has been the rapidly increased efficiency and productivity of our farms. Among those who are contributing to the new records being established almost every year are the new homesteaders and farmers developing new private farms on recently constructed western Reclamation projects, such as the Northside Pumping Division of the Bureau of Reclamation in south central Idaho.

Here is a stellar example of what the mechanical revolution on the farm has done in comparatively recent years. While our basic interest lies in the production of sugar beets throughout this entire section of Idaho, it must be noted that numerous other crops are doing very, very well on lands that until only a year or two ago were sagebrush-covered wastelands.

Not long ago, producing a good sugar beet crop on this new land would have been an impossibility for at least several years. There would first be the period of building the soil with legume crops and adding humus through production of straw crops.

Today, with new cultural practices, our new Idaho farmers obtain high yields of beets soon after clearing the land and treating it in accordance with modern fertilization methods.

Before World War II, getting new land ready for production was a long and arduous task. Once the water was made available for the land, then came the laborious clearing—by hand, with horse-drawn equipment or with small tractors. And in Idaho, sagebrush resists clearing with stubborn determination to remain rooted in the soil.

After clearing, the next struggle was leveling the land so that it could be irrigated without having dry high spots and water-logged low spots. The result, during the years before modern methods were adopted, usually was a piece of land with light, dusty soil devoid of humus, subject to wind and water erosion and prey to rodent depredation. Livestock feeding was essential in those days to provide the fertilizer so desperately needed to put the land in production. Thus it was that long years of painstaking work were required to build the soil to its productive potential.

by H. A. ELCOCK, General Agriculturalist, The Amalgamated Sugar Company, Ogden, Utah

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This Excellent field of SUGAR BEETS was grown on third crop year.

The contrast between the old methods and the plan of attack employed by our present-day sugar beet growers and new Idaho farmers is amazing, even to many of us who have lived through both eras and have observed the giant strides made since the last war. On the Northside Pumping Division water is obtained either from wells or by pumping from the Snake River.

The new farm developers move in with large specialized sagebrush cutters and windrowers powered by huge crawler tractors and frequently erase the brush from as much as 40 acres a day. While the average land in the area requires a relatively small amount of levelling to prepare it for irrigating and cropping, large and efficient land levellers are now employed and the job requires but a fraction of the time and labor once devoted to this phase of the development work.

Because cash outlays are required to develop the land and pay maintenance, operation and capital costs of the irrigation project, little time can be wasted by the new farmer in producing cash crops. Wind erosion is another factor which requires planning and clearing and levelling to be finished just in time to get a crop planted.

Along with the famed sugar beet, the new south central Idaho farmer usually turns to potatoes, grains, peas, beans and alfalfa for his cropping rotation. Grain land can be prepared early in the spring using a liberal amount of commercial fertilizer—about 100 units of nitrogen per acre—and will result in a crop of from 60 to 75 bushels per acre. The grain often is used as a nurse crop for alfalfa, or is grown for the straw to be plowed under for humus and prevention of wind erosion on the light soils.

Potatoes have proven to be an excellent first cash crop on this new land. By addition of 250 to 300 units of nitrogen and 100 to 150 units of P_2O_5 per acre, excellent quality and quantity potatoes can be obtained in the first year. This generally can be repeated successfully for a second year, if desired.

After one or two crops of potatoes, sugar beets, peas or beans can be grown with great success. Sugar beet crops exceeding 25 tons per acre are not unusual on this new land within a year or two of its clearing. It has been demonstrated that the tough and valuable sugar beet is an ideal crop following potatoes or peas, since the land is then well settled for irrigation and good cultural practices can be carried out to assure large yields. With the addition of 200 units of nitrogen and 100 units of phosphoric acid per acre, excellent sugar beet crops are obtained on this new project land.

The new methods of commercial fertilization and the correct use of irrigation water on Idaho's new Reclamation farms have enabled these lands to compete successfully with older established farms in the area. Cash crops are now a part of the first year's farming and the old established method once employed of spending seven to ten years building up the generally low nitrogenous western soils is a thing of the past.

It is commonplace in southern Idaho and on new lands to produce in the first year 200 cwt. of excellent quality potatoes per acre, 60 to 75 bushels of wheat, 30 to 35 bushels of seed peas or 3,000 pounds of process peas. The second and third year bring the excellent sugar beet yields common

(Continued on page 111)

First cutting of alfalfa on a Palisades Project irrigated farm east of Ririe, Idaho.

Photo by Phil Merritt, Region 1.

Guy C. Jackson

W. A. Dexheimer

Floyd E. Dominy

N R A MEETS IN HOUSTON

As this issue went to press the 27th Annual Convention of the National Reclamation Association was scheduled to be held at the Rice Hotel, Houston, Texas, on Wednesday, November 19, continuing through November 20 and 21.

Secretary-Manager William E. Welsh arranged the preliminary plans for the convention after conferring with President Guy C. Jackson and other officials of the Association from the various Western States. Indications were that the meeting would be well attended and the speakers would include nationally known authorities in the field of water resource development.

The theme of the convention will be "RECLAMATION—Development of the West and Food for our Rapidly Increasing Population."

Under Secretary of the Interior Elmer F. Bennett was scheduled to deliver a principal address entitled "The Case for Reclamation."

ONE OF THE HIGHLIGHTS of the convention will be a boat trip down the Houston Ship Channel and a tour of San Jacinto Monument and grounds.

In addition to Under Secretary Bennett and President Jackson, others scheduled to address the convention included leading members of the House and Senate Interior and Insular Affairs Committees; Governor Price Daniel of Texas; General E. C. Itschner, Chief, United States Army Corps of Engineers; Donald A. Williams, Administrator, Soil Conservation Service; and Reclamation Commissioner W. A. Dexheimer.

In addition to the foregoing it was also hoped to have Governor George D. Clyde of Utah, Dr. Luna B. Leopold, Chief Hydraulic Engineer of the Geological Survey and J. W. Grimes, President of the Association of Western State Engineers as speakers.

Other Interior and Reclamation officials selected to attend the 27th Annual Convention of the N. R. A. were Solicitor George W. Abbot; Associate Commissioner of Reclamation, Floyd E. Dominy Associate Solicitor, Water and Power Edward W. Fisher; Assistant to the Commissioner-Information, Ottis Peterson; Chief, Division of Irrigation, William I. Palmer; and Chief, Division of Project Development, N. B. Bennett.

# # #

National Employ the Physically Handicapped Week has been designated as October 5–11 by President Dwight D. Eisenhower. This is the fourteenth year in which the "Week," which only points up the problem, will be observed. The program for employing the physically handicapped includes every week in the year. There can never be any relaxation in the continuing programs that are carried out at the national, State and community levels in the interest of these people. The following is an account of a few handicapped persons employed in Reclamation areas.

Beatrice P. Salisbury

Hire The Handicapped—It's Good Business

MRS. BEATRICE PRICE SALISBURY, who works as a general clerk in the Bureau's Palisades Project office, in Idaho, dislocated her right hip at the age of ten. She received various treatments but these proved unsuccessful and eventually resulted in tuberculosis.

This necessitated her spending a long period of time in a sanitarium.

However her determination to live and learn eventually saw her teaching shorthand and typing in the Gem State Business College in Idaho Falls, Idaho, by the time she was 20. The following year she married an Iowa farmer and they now have four children. It is necessary for Bea to have a brace on her leg while working and use crutches for long walks. However, in 16½ years of Government service she has lost only one day of work as a result of this original handicap.

Earle E. Harrison

It is her philosophy that being handicapped makes a person more determined to succeed, develop other skills for lacking ones, and makes her children more self-reliant by doing for themselves instead of depending on her.

EARLE E. HARRISON lost his right hand as a result of a childhood riding accident. His excellent adjustment to this handicap is reflected in his record of long and successful Government service.

Before his transfer to the Bureau of Reclamation in 1947, Mr. Harrison had been employed by several other Government agencies as an Engineering Aid and as an Electronic Engineer Instructor. His experience in the Bureau of Reclamation has included work in inspection, materials, and office engineering. Although much of his work had involved surveying and other field assignments, he has never permitted this handicap to interfere with the efficient performance of his duties, as is evidenced by his advancement to the position of Construction Management Engineer.

Mr. Harrison's cheerful personality and professional ability have earned him the friendship and respect of his fellow employees on the Washita Basin Project.

JOE G. BARNES is employed as a student Trainee (Engineering) in the Grand Junction Projects Office of the Bureau of Reclamation and is working on routine laboratory tests of concrete materials and earth materials. He is qualified and has in the past held a full-time job on a survey party. He has a very pleasant personality and he performs his work well even though he lost practically all the use of his left arm as a result of polio when he was one year old. Although the polio left him with some grip in his hand, he is unable to move his arm freely.

Mr. Barnes has overcome his handicap to an amazing degree. He swims, plays tennis and baseball, and can drive a farm tractor and operate other farm equipment.

Joe was born in Santa Anna, Texas, and was reared on a farm near there. He is a senior at Colorado University at Boulder, Colorado, where he is majoring in Geology.

Joe G. Barnes

CARL E. BUSSE, draftsman in the Missouri-Oahe Projects Office at Huron, South Dakota, has been with the Bureau of Reclamation since 1943, working first on the Buffalo Rapids Project at Terry, Montana, and since 1948 at Huron. Carl is very nearly deaf, his handicap resulting from an ear infection suffered when he was 9 years old. Nevertheless, he spent about 7 months in the Army during the latter part of the First World War, and then served as County Engineer at Big Timber in Sweetgrass County, Montana, from 1922 to 1943. He has about three years training in Civil Engineering at Montana State College. He is very capable and efficient in his work. He misses the comradeship of conversing with his fellow workers and friends but mostly he misses music and shows. Carl reads and studies, does his own housekeeping and cooking, and every year makes a trip back to Big Timber to visit his old friends.

He will retire on November 30, 1958, and plans to go back to Big Timber and "run out a ditch or two" for some of the irrigators in Sweetgrass County.

HARVEY E. BENDER is employed as Supervisor of the Bureau of Reclamation's Soils Laboratory at Huron, South Dakota. Mr. Bender is an excellent example of a well qualified physically handicapped person doing fine work in the field of his choice.

A veteran of World War II, he was stricken with a severe case of polio in November 1948, 2 years after discharge from the service. He spent one year in the hospital suffering from general paralysis of the body, especially the legs. As a result of good hospital care and

Carl E. Busse

faithful effort on his part, he recovered use of all faculties except his legs; which requires that he use a cane much of the time.

In 1949, he entered Huron College, Huron, South Dakota, and attended 2 years. During the Spring of 1950, he was employed part time at the Bureau of Reclamation soils lab, Huron, South Dakota. In the Fall of 1950, he was transferred to the Bureau of Reclamation soils laboratory at South Dakota State College. Continuing part-time work for the Bureau, he graduated in June of 1953. In September of 1953, all soil and water testing was transferred to a fully equipped laboratory in Huron, South Dakota, where Mr. Bender has been in charge since that time.

He holds a B. S. degree from South Dakota State College majoring in the field of soils.

Harvey E. Bender

MELVIN L. MEDIGER is Chief, Personnel and Office Services Branch in the Missouri-Oahe Projects Office, Huron, South Dakota. He is responsible for all office service functions and that portion of the personnel function as delegated to that office. He is an outstanding example of a physically handicapped employee putting out highly satisfactory work.

A veteran of World War II, 34th Division, European Theater, he lost his right leg by shrapnel at San Peatro, Italy, in January 1944. Upon his discharge from the service, Mr. Mediger was fitted with an artificial limb which is not apparent except for a slight limp and the cane that he carries.

Normally an active outdoorsman, he had to temper his activities to this new handicap. However, with a wife and three active sons ranging in age from 6 to 13, he has overcome this physical restriction and sets a fine example in his community in boy scout work and in his office for his enthusiasm for employee participating parties, picnics, welfare and benefit programs.

IRVIN I. SIMMONS served with the 47th Infantry Regiment, 9th Infantry Division during the campaigns in North Africa and Sicily and in Normandy until injured. His right leg is paralyzed below the knee from shell fragments received in this injury and he walks with a slight limp which is not apparent to many people.

He was honorably discharged from the service in 1947 after several unsuccessful operations to repair the damaged nerve. Subsequently, he attended South Dakota State College in Brookings and completed the Electrical Engineering course, gaining his B. S. degree in June 1951.

In June 1951, he entered on duty as an Electrical Engineer with the Bureau's Missouri-Oahe Projects Office at

(Continued on page 108)

STATUS OF SALINE WATER CONVERSION

by HON. FRED G. AANDAHL
Assistant Secretary of the Interior

FRED G. AANDAHL
Assistant Secretary of the Interior

Under the provisions of the Saline Water Conversion Act of 1952 (P. L. 448, 82d Congress, 2d Session, as amended), the Department of the Interior was given the responsibility of carrying forward the Saline Water Conversion program. David S. Jenkins, Director, Office of Saline Water Conversion Studies, has been in direct charge of the program. It has been carried forward under the supervision of the Assistant Secretary of the Interior, Hon. Fred G. Aandahl.

The intriguing possibilities of using converted sea water to support life in plants and animals have engaged the interest of men for many years. The first successful use of sea water for drinking water is lost in antiquity, but probably antedates by 200 years or more the Rhyme of the Ancient Mariner:

> Water, Water everywhere
> Nor any drop to drink.

Evidence of the use of distillation appears as early as 1593 when Sir Richard Hawkins is said to have used a still for fresh water supply while en route to the South Seas. Other references trace the development of the simple still for shipboard use down through the eighteenth century.

Some 167 years ago, Thomas Jefferson, then Secretary of State, wrote a treatise on the subject of distillation. To determine the merit of the process by experimentation, he asked the help of the American Philosophical Society, the College of Philadelphia, and the University of Pennsylvania. A certain Mr. Isaacks, as the story goes, "fixed the pot, a small caboose, with a tin cap and straight tube of tin passing obliquely through a cask of cold water; he made use of a mixture, the composition of which he did not explain, and from 24 pints of sea water, taken up about 3 miles out of the Capes of Delaware, at floodtide, he distilled 22 pints of fresh water in 4 hours, with 20 pounds of seasoned pine, which was a little wetted by having lain in the rain."

Such scholarly and historical interest in salt water conversion was abruptly put to the test of urgent practicability by the onslaught of World War II. The many cases of persons afloat in small boats brought about by the aircraft and surface-ship casualties resulted in a surge of experimental work in this field. British and American investigations explored a number of possibilities and the armed forces adopted the use of cans of fresh water and plastic bags for chemical freshening of sea water.

Meanwhile, the exploitation of mineral deposits in arid areas such as Chile, the concentration of population in semi-arid regions such as Palestine and our southern California, and the heavy pollution of our rivers have at various times further stimulated the consideration of demineralizing saline waters.

In 1929, for example, we find mentioned the use of condensate from a coal mine power plant in Kentucky. This installation is reported to have produced about 40,000 gallons per day of distilled water. A triple-effect plan for Kuwait on the Persian Gulf was fabricated in 1949 with a capacity of about 700,000 gallons per day. Recent additions to the Kuwait plant have increased the daily capacity to 5-million gallons per day making the tiny Skiekdom the world's largest producer of converted water.

An extended drought in California aggravated the water problem in that semi-arid state during the 1930's and 1940's and resulted in the introduction of proposals to the Congress for appropriations of funds to study the various methods of demineralizing sea water.

Thus, we find scattered instances of man's earlier endeavors in this field.

Reflect for a moment on some of the published statistics on our water uses in this modern age. Eighteen thousand gallons of water to make a ton of ingot iron; 65,000 gallons to convert this ton of iron into steel; 7,000 gallons for a barrel of gasoline; 160 gallons for a pound of aluminum or a pound of synthetic rubber; 3,600 gallons for a ton of coke. On the farm, a pound of beef on the hoof has required 3,750 gallons of water for the steer and the grass he eats; and a slice of bread including the growing of the grain has used 37 gallons of water. In our homes and farms and factories, the use of water amounts to 1,500 gallons a day for each man, woman, and child.

By 1975, with a population of 220 million, we may be withdrawing for use as much as 440 billion gallons a day of this precious resource—almost double our present use. The present upper limit of our water supply is the average runoff, nearly 1,200 billion gallons a day.

On the whole, then, the water supply of the country is adequate. But because the supply is variable in time, in place, and in quality, national and yearly averages do not reveal the cold fact that many localities and regions have serious supply problems. The recent drought in the Southwest made it dramatically clear that water shortages may have a devastating effect upon the people and the economy of a region. The social and economic distress caused by failing public supplies is another painful reminder that our people must maintain an alert interest in their local water supplies, present and future.

The consumption of natural resources has increased out of all proportion to our increase in population. From 1900 to 1950 the population of the United States doubled, but the consumption of power increased 11 times, the production of all minerals increased 8 times, and the consumption of electrical energy about 60 times.

In addition to the growing deficiencies in the quantity of readily available water, the natural salinity of many of our inland streams and underground waters together with the effects of expanded irrigation, industry, and population have created a national problem of water quality. While acute localized shortages had been suffered in certain locations, it was not until the need for improvement of the many brackish inland waters arose in addition to the possibility of converting ocean water that the problem was viewed as a national one.

In 1952, the 82nd Congress enacted Public Law 448. This Act authorized the Secretary of the Interior to provide for the development of low cost processes for converting saline water to fresh water for agricultural, industrial, municipal and other uses. This program is under the Office of the Assistant Secretary of the Interior for Water and Power Development and is administered through a small administrative and scientific staff in the Office of Saline Water. The information being presented here is derived from the reports and publications of that Office.

The authorized program was designed to encourage private research and development in this general area and to assist such private effort by means of a program of Federally financed research and development contracts where private activity alone did not seem to be making sufficient progress. Public effort both local and Federal was to be coordinated for the purpose of accelerated research and development.

In 1955 by amendments to the 1952 Act, the original small program was extended in time to a total of 14 years from the date of the original act and expanded in scope through increasing of the authorization from $2 million to $10 million over that period, 1952–1966. So far, just over $4 million has been appropriated. It is evident that this program, which has cost about one-half million dollars annually for 6 years, cannot be compared with large Federal programs that the Congress has authorized on a basis of urgency. Moreover, the present program is restricted to serving needs within the United States.

With a view to obtaining the greatest practicable participation of private knowledge and skill, an active campaign was developed at the outset of the program to bring together all existing and new ideas on conversion methods for research and development, and to enlist the cooperation of engineers, scientists, and organizations in exploring these ideas and methods. A brochure, "Demineralization of Saline Waters," was compiled and distributed, outlining all known phenomena or processes that might be considered for saline water conversion. Interest so developed was further stimulated by publications, addresses and other contacts with scientific groups.

Some results of this stimulation of technical interest became apparent. At the recent International Symposium on Saline Water Conversion, held in Washington in November 1957, more than

300 scientists and engineers working in this field, from 16 countries in addition to the United States, took part, presenting 39 scientific papers, which brought out a large number of scientific ideas and views.

Experience has shown the need for a proper perspective on the costs of conversion of saline waters. At the outset of our program, we analyzed the cost estimates made by advocates of the various processes. It was found that few of these early estimates, if any, included all actual costs. Further, many such estimates of 5 or 6 years ago represented optimistic extension of laboratory results to future large-scale application. Thus, for example, it was estimated that projected large-size distillation plants utilizing processes then in commercial production could convert sea water to fresh water at a cost of $1.25 to $1.50 per thousand gallons of product. Overlooked by some was the fact that such large scale operation had not been actually accomplished. The actual cost of large output conversion of sea water today by conventional processes is about $2 to $3 per thousand gallons. Even in recent months, optimistic announcements of conversion costs running as low as 20 cents per thousand gallons have been made, but these also have been carefully investigated by the Department and have been found to represent only a minor portion of the total costs.

The most promising of the conversion methods now under development include several distallation and membrane separation processes, and one form of salt water separation by freezing. For these, pilot plant work is needed and in part is already in progress to explore their economic feasibility and potential fields of application. Other processes, still in the laboratory, are recognized as justifying further investigation. Still other approaches to conversion have on investigation been found to lack sufficient promise of practical value.

Laboratory and economic study to date has narrowed the field from some twenty phenomena or processes to five broad groups: (1) distillation through artificial heat; (2) solar heat distillation; (3) separation of salt water by membrane processes, of two or possibly three kinds; (4) freezing; and (5) other chemical or electrical means of separation, including solvent extraction.

It has been ascertained that the various potential processes are suited to different conditions, as they offer partial answers to the complex overall problem of providing fresh water from different saline sources, in different locations, for different uses, and in different quantities. Some processes may be best adapted to supply of an individual farmstead or home, others to furnishing millions of gallons per day to a city or an industry.

As one result of the work under the Saline Water Conversion Act, three new or improved distillation methods are under pilot plant development or ready therefor, and several leading industrial companies are taking part in further development.

Electrodialysis using ion-exchange membranes, which five years ago was little more than a laboratory phenomenon, is now a commercial reality, and other membrane processes are about to enter the pilot plant phase. The possibilities of separation by freezing had received some attention at the beginning of the program, but entrapment of brine in the ice crystals was an unsolved difficulty; since then, research has developed a successful ice-washing process, and a composite freeze-evaporation cycle has been sufficiently tested for pilot plant design. One of the attractive features of this process is the smaller quantity of energy required for freezing as compared to that for evaporation.

Two modified distillation processes, one based on vapor-compression, the other on multiple-effect evaporation, progressed to initial field testing in December 1957. The former is represented by the Hickman rotary still as designed to produce 25,000 gallons of distilled water per day. The other test is directed toward scale prevention, for application to a distillation cycle proposed by W. L. Badger utilizing long tube vertical evaporators. Test units have been installed at a seashore location at the test station of the International Nickel Company, Harbor Island, North Carolina.

Membrane processes became increasingly important, particularly for conversion of brackish waters, with the availability of improved membranes at lower cost for electrodialysis. Field tests in Arizona and South Dakota had shown a year ago that electrodialysis equipment can be operated satisfactorily on several types of brackish water, but it is now clear that it will be necessary to develop lower cost equipment. Work to this end is being undertaken at the Bureau of Reclamation laboratories in Denver, where evaluation tests of membranes, including types newly developed by the Dutch, are also under way.

Solar heat distillation, which has demonstrated its feasibility and its usefulness as a conversion process under appropriate conditions, is also circumscribed by high costs of installation and maintenance, and will depend for extension of use on reduction of these costs. Under contract with Battelle Memorial Institute, small solar distillation pilot plants are being erected in Florida.

Separation of salt water by freezing has been found most promising when embodied in a conversion process which uses vacuum evaporation in combination with ice formation. Results so far obtained are sufficiently promising to warrant pilot plant development. Several other potential conversion processes are still in the laboratory state.

Private industrial firms have been developing and improving distillation equipment for a considerable period without Government assistance. Many such conversion units are in use on ship-

board and several much larger land-based installations are supplying potable water to industry and populations in over a dozen locations throughout the world.

Private industry has furthered the conversion of saline water more recently by improving distillation processess, developing electrodialysis equipment, and in producing greatly improved ion-selective membranes. Many firms have also contributed advice, cost information, new ideas, data on fabrication costs, and similar aid to the Department in its evaluation of equipment and practical application of new processes and devices.

A number of manufacturers have announced their intentions of developing processes in the future that might produce potable water for about $1 to $1.50 per thousand gallons, although present costs of the most recent commercial conversion plants using sea water range from about $2 to $3 per thousand gallons.

As we view the broad field of salt water conversion, we question whether any radical or sudden advances in technology can be expected that would bring about a drastic reduction in the cost of conversion. We look instead for a gradual reduction in costs—through the development of new or improved processes by way of the pilot plant stage, and through much more basic and exploratory research.

Progress so far has been most encouraging. The next step in our work, in addition to the continuation of basic research and small pilot plant experimentation, is the construction of experimental demonstration plants for the more promising processes. We are confident that with the continuing support of the saline water conversion program by the Congress and the continuing activity of the numerous non-Federal interests in the field, the age-old objective of obtaining fresh water from salt water will surely be attained on a large scale for irrigation, industrial, and municipal use. # # #

WATER

IS THE PRICE TOO HIGH?

The dollar cost of providing increased water supplies under current conditions will be high. Will it be too high?

It might appear to be more economical to wait for a downward curve in the whole structure of prices and wages before undertaking the kind of construction programs required to meet our needs. But where are the signs that such a curve is in the making? And how long can we wait?

Every hot, dry summer imperils the water supply of many millions of people. Suppose next year—or the year after—brings similar conditions? Picture a shortage that goes beyond the critical stage. A few years ago New York was only days away from such a crisis. Some smaller places have gone through it.

Picture a water supply inadequate to handle a serious fire. Picture a water supply insufficient to maintain proper sanitation. Picture a water supply no longer able to keep industrial processes functioning.

The price of keeping pace with the need for water may seem high, but what about the price of failure? One uncontrolled fire, one epidemic, a group of major industries lost to the community—any of these could involve an expense beside which the price of improved water supplies—even with costs what they are—would hardly be noticeable.

Water is essential to life—the life of a city as well as the life of a human being. Without water, a man dies. Without water, a community faces the same fate.

In the face of a crisis, no price can be too high. High prices paid to prevent a crisis are low prices! And the community concerned with getting the most for its money doesn't just keep pace with water needs, but stays five or ten years ahead of them, for water works aren't built in a day—especially a day of emergency!

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WOMEN VOLUNTEERS WANTED FOR ERA

The Secretary or some other officer of each and every organization of women on our projects is requested to take her pen or typewriter in hand and write to J. J. McCarthy, Editor of RECLAMATION ERA, *and outline her views as to how the* ERA *may best serve the interests of our project women. The same invitation is extended to every woman not connected with a women's organization.*

The ERA *wishes to be of service to everyone on the projects—men, women, boys, and girls. Just now the call is for women volunteers without whose cooperation this proposed feature of the* ERA *cannot be a complete success.*

Write today!

VEGA DAM—*Reclamation's Newest in Western Colorado*

by H. E. SIMISON, Special Services Officer, Region 4

Vega Dam will store the water of Plateau, Leon, and Park Creeks. Feeder canals will deliver flows from Leon and Park Creeks into the 32,700 acre-foot reservoir. Vega Reservoir will supply urgently needed water to supplement deliveries to 18,340 acres of presently irrigated land in the Collbran Project area. A full water supply will also be provided to 2,310 acres in new irrigated farms.

Weather is the big problem faced in building Vega Dam. Located at about 8,000 feet elevation on the north flank of the famous 10,000-foot high Grand Mesa (the largest flat-topped mountain in the United States), the winters are snowy and the springs are rainy. Placing of earth in the dam proceeds from about May 1 to November 1 with brief interruptions by summer showers.

In winter, snowfall ranges up to 135 inches or more, and snow piles up to 4½ feet deep on the level. Spring rains often make the earth in the borrow areas too wet to place in the dam, and the haul roads too slippery to use. At such times, there is nothing to be done but to shut down work and wait until everything dries out.

Even so, Vega Dam will be completed by September 1959, ahead of the time allowed under the $1,707,000 contract with the C. F. Lytle Co. of Sioux City, Iowa.

The 29-mile long Southside Canal, with initial capacity of 240 cfs, will thread its way from the Vega Reservoir down through the Collbran Project lands on the several "mesas" (benchlands) along the south side of Plateau Creek. Water will be delivered from the Southside Canal to existing ditches of the Collbran Project.

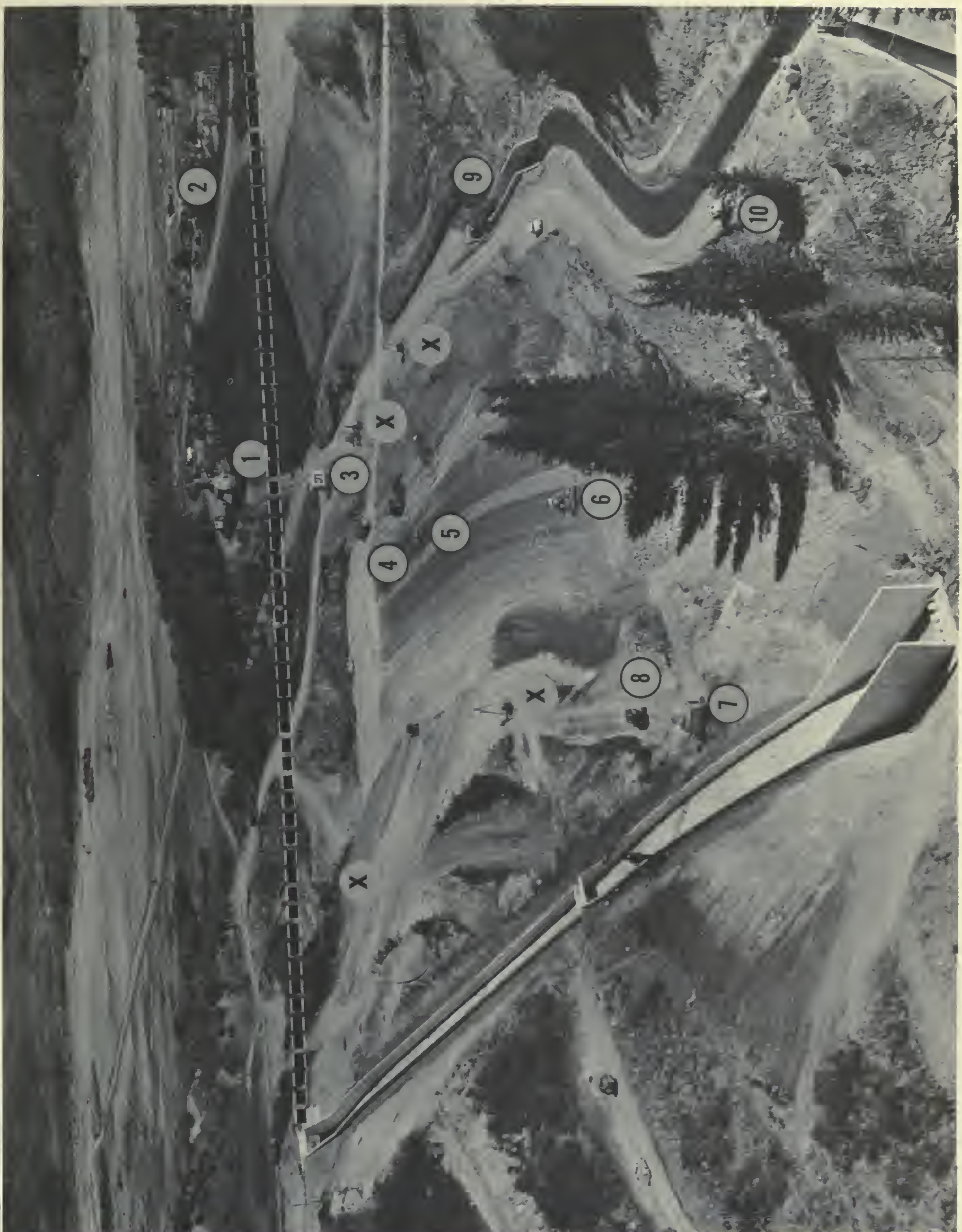
Two powerplants—the Upper and Lower Molina Powerplants—will be built with total installed capacity of 13,000 kilowatts. New pipelines will carry water from existing small reservoirs on Big and Cottonwood Creeks to the powerplants. In addition to increasing the water supply for all irrigable lands on the Collbran Project water from the Southside Canal also will be delivered to replace the water diverted for the powerplants.

Construction of the Southside Canal will start with the award late in 1958 of a contract for excavation and lining of a 6-foot, 3-inch, horseshoe-shaped tunnel, 2,300 feet long.

The storage to be provided by construction of Vega Dam is the key to a reliable water supply for the Collbran Project. In August 1958, Vega Dam was about two-thirds completed. The spillway and outlet works were largely completed, and the embankment of the dam had risen 40 feet above the bed of Plateau Creek.

In a year or two, Vega Reservoir will be a favorite fishing spot for many people from the surrounding countryside, since it will be accessible for fishing earlier than the many lakes high on Grand Mesa. #

VEGA DAM, at right: Vehicles and work stations were in operation when this aerial photo was taken over Vega Dam site near Collbran, Colo., east of Grand Junction. Broken line across the photo shows where the top of the 145 foot high dam will be. Four X's in center area are at floodlight towers mounted on skids used by night shift workers. Project engineer Edward H. Jeffries of the Bureau of Reclamation looked at the photo and explained some of the other objects, which are numbered as follows: 1—The concrete plant; 2—Heavy equipment repair shop; 3—Trashrack intake structure which will release reservoir water to canal; 4—Bottom-dump trucks which are hauling clay to the dam bed; 5—Caterpillar tractor pulling a scarifier which loosens packed surface so it will bond with the next layer of clay; 6—Sheepfoot packing roller being pulled by tractor; 7—Crane pouring concrete from a massive bucket through "elephant trunk" to gutter alongside the curving spillway structure; 8—Truck which hauled the concrete; 9—Canal which carries the water of Plateau Creek under the dam bed while work is in progress, and 10—Air compressor for jack hammers, tampers and other pneumatic equipment. The dam, being built at a cost of $1.7 million, will be 2,100 feet long at the crest, 700 feet thick at the bottom, and 30 feet wide at the top. The reservoir it backs up will hold 33,000 acre-feet of water and will be 2½ miles long and a half-mile wide. The construction firm building the dam is the C. F. Lytle Co. of Sioux City, Iowa. Completion of project is slated for 1963. ***We are indebted to Mr. Monk Tyson and the Denver Post for this photograph and the caption information.***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Highway in the Sky

In the high plateau desert near the Arizona-Utah border, men and machines matched their skills and energies against the forces of nature to build the world's highest bridge. Over the muddy streak of the Colorado River far below, two half arches of steel project out from the 700-foot vertical cliffs of pink sandstone. This was the start of the Glen Canyon Bridge which will someday be a crossing point of Highway 89, a major thoroughfare spanning the southwestern part of the United States.

Against the vastness of this canyon, the spider webs of steel slowly arched toward their closure point midway between the 1,028-foot gap. When that closure was made on August 6, 1958, it was a day of great rejoicing for the bridge workers of Kiewit-Judson Pacific-Murphy, contractors for the bridge. It was also a day of rejoicing for Bill Choate, project superintendent for Kiewit-Judson Pacific-Murphy, and for Al Tokola, the project engineer. These men were chiefly responsible for laying out the method of erection for this arch span.

Some 4,000 tons of structural steel will eventually go into this bridge which, when completed, will provide a 30-foot roadway across the canyon.

Although under separate contract, the bridge is an integral part of the multimillion-dollar dam which will be located upstream from the bridge.

Before any steel work could be accomplished on the bridge, the contractor had the task of setting up a camp site and building access roads into a wilderness area. After constructing the barracks and mess hall on the west side of the canyon, Kiewit-Judson Pacific-Murphy took on the problem of transporting men and equipment across the 1,028-foot chasm that separated the east and west sides of the river. They soon had a 1,500-foot cableway in operation across the canyon. Running from a 100-foot tower on the right bank to a 110-foot tower on the left bank, the 2-inch track strand had a load capacity of 12½ tons. A second and heavier 25-ton capacity highline cableway was erected to aid the steel erection of the arch span. The head tower of this highline, which is located on the left bank or west side,

by FRANCIS J. MURPHY, Project Manager, Kiewit-Judson Pacific-Murphy

ABOVE, final adjustment of key chord.

is 165 feet high and the tail tower on the right bank or east side is 150 feet high.

The towers were capable of luffing horizontally 21 feet in either direction, allowing them to cover the bridge from any point.

After some 4 months of cliffhanging, the survey crews obtained their prime controls which were checked out by the Bureau of Reclamation, and the abutments and skewbacks for the bridge were surveyed in.

The erection of the bridge was a carefully planned step-by-step arrangement to bring the two half arches together midway across the gorge. With the closure point reached and the two half arches converted into a continuous arch span, the bridge was transformed from a three-hinged arch to its design condition as a 2-hinged arch.

Tiebacks were necessary to hold the panels of the arch sections as they progressed to the closure point. Seventy-two of these tieback lines were used.

The tiebacks consist of Bethlehem 1½ inch bridge strand and were supplied in special lengths through Bethlehem Pacific Coast Steel Corporation. The rope is prestressed and has an ultimate breaking strength of 138 tons per strand. The strands are connected to the tops of 100-foot towers at each side of the canyon. These towers are composed mostly from secondary steel members—the post and floor beams which will eventually be used in the bridge when the arch span is completed. The towers are anchored by back guys, also composed of bridge strand. Sixteen of these back guys were tied into the tops of each side of the two towers. They are fastened to deadmen with flat link bars imbedded in the reinforced concrete of the deadmen. Each deadman fills an excavation 22 x 25 feet wide and 15 feet deep in the solid sandstone.

L. to R.: Truck crane servicing job, head tower of 12½-ton cableway, tail tower of 25-ton cableway, and tieback tower.

In the erection sequence, the first lower chords of each of the half arches are anchored to the skewbacks with 16-inch diameter pins which become the permanent anchorages for the bridge. The upper chords of the arch panels do not connect the skewbacks but are held up by normal truss construction aided by tieback lines which are anchored to their half arches by strongbacks.

The point of closure is 21 panels out from both sides of the canyon. When reached, 18 tiebacks were in use on each of the four upper chords. Ten strands were tied off at the 15th panel point of each chord. Hydraulic jacks were positioned at each strongback. Simultaneously taking tension off two strands at each of the upper chords, the two half arches were lowered. 20-inch diameter pins were then inserted in the final upper chord

First 4 panels of steel being set on the right bank or east side of Glen Canyon.

Key chord being lowered into position. Photo by J. L. Digby, Region 4.

members, closing the arch into a 3-hinged structure. The two lower chords coming together at the 21st panel were designed so that they telescoped into each other. Five-hundred ton hydraulic jacks were positioned between each of the opposing lower chords. A precise loading depending on the temperature was supplied at each jack. When this was accomplished and it was determined that the arch was aligned, the interleafing plates in the lower chords were field drilled, aligned with drift pins and then riveted.

When the load was relieved on the jacks, the bridge was transformed into a 2-hinged arch. The crown of the lower chord members of the arch is 165 feet above the point where the lower chords pin into the skewbacks.

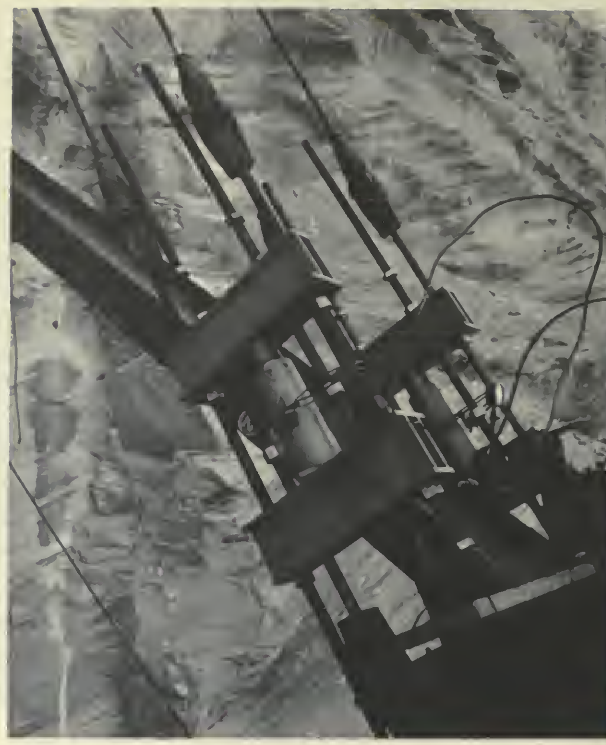
The roadway deck, at an elevation some 700 feet above the canyon floor and 113 feet higher than the dam crest, will provide motorists with an excellent view of the dam and reservoir.

Structural steel members for the bridge were fabricated at the Judson Pacific-Murphy Corporation plant in Emeryville, California, and shipped by rail to Flagstaff, Arizona. They were then trucked to the town of Page, which the Bureau of Reclamation is building, on the east or right bank of the canyon.

Bridge building is at best a difficult work, for bridges seem to find their reason for existence in hazardous and inaccessible regions. However,

Completed arch. Billow of smoke resulted from blast set off to signal the closure of the two half arches.

Picture shows detail of the tiebacks with the sections for distributing tension in place.



the compensation for this work comes in the thrill of the acceptance of the challenge and the ultimate conquest of the obstacles invariably presented by nature.

This bridge was no exception. The challenge was accepted! # # #

AVOID FERTILIZER INJURY

Nitrogen and potassium salts in fertilizers are soluble. If large amounts are placed with or very close to the seed of young plants, delay in growth or loss of stand may result. The salts dissolve in the soil water and the plant may suffer from reduced moisture availability. Water with salts dissolved in it has an increased "osmotic pressure" and plants cannot absorb the water readily. Too, a high salt content actually may be toxic to the roots.

The solution of salts will move upward when the soil dries out. If fertilizers high in soluble salts are placed directly below the seed, upward movement of the salt will bring heavy concentrations into the area where the seed is germinating or the young plant is developing. Likewise, if fertilizer is placed above the seed, light rains will wash the salts down around the germinating seed. Of course with plenty of rainfall after planting, little difficulty will be experienced.

WATER REPORT

by HOMER J. STOCKWELL, Snow Survey Supervisor, Soil Conservation Service, Fort Collins, Colo., and NORMAN S. HALL, Snow Survey Leader, Soil Conservation Service, Reno, Nev.

Another good year was experienced by water users in the western United States in 1958. Following heavy runoff in 1957, high streamflow and good carryover storage provided an adequate water supply. Isolated local water shortages occurred along streams where little or no storage was available.

As with most water supply situations, the one this year was unusual. Concurrent with the excellent irrigation water supply, a severe short-term drouth was recorded, particularly west of the Continental Divide. From midsummer through early fall, precipitation was only a small fraction of normal. Another unusual characteristic of water management was bank full streamflow in several areas where regulated flows are normally maintained. This year, reservoirs for local storage were full and there was little or no demand for water during the peak of snowmelt. In some of these areas, due to lack of rainfall, late season flow was deficient. It was necessary to draw heavily on stored water. In a few areas, water users were faced with a late season shortage after early season uncontrolled losses.

The heavy snowpacks on the Sierra Nevada and limited areas of Utah, Colorado, and New Mexico caused little damage. The lack of late spring precipitation along with definite advance plans for use of available reservoir storage averted serious damage.

With recent drouth years still a vivid memory, plentiful water years such as 1957 and 1958 serve as a reminder that additional storage is needed, not only to better distribute water through the irrigation season, but also over the years of drouth and plenty.

In Arizona and New Mexico, surface water supplies were the best since 1952. A long trend of drouth was reversed. Reservoir storage generally increased during the irrigation season. Runoff into the Central Valley of California was over 150 percent of normal following a good winter snowpack increased by severe storms the first week of April. Practically all major reservoirs were filled. The Columbia Basin States of the Northwest also had plentiful water supplies. With a normal runoff there was some depletion of reservoir storage reserves from a year ago. A similar situation exists in the Rocky Mountain area.

(Continued from page 105)

Water supplies were at least adequate. Storage in smaller irrigation reservoirs is down some 10 to 25 percent from a year ago, but still range near 150 percent of normal. Storage in larger reservoirs has tended to increase. Summer rainfall was near normal east of the Continental Divide. The west slope of the Rockies shared in the general midsummer and early fall drouth.

Outside of the Central Valley of California and adjacent areas in Nevada mentioned previously, seasonal runoff was rather nominal. The flows for the April 1–September 30 period of the major streams of the West are indicated by the following provisional records in approximate percent of normal: Colorado River at Grand Canyon, 105 percent; Rio Grande at Otowi Bridge, 125 percent; Columbia River at The Dalles, 100 percent; and the Missouri River at Fort Benton, Mont., 85 percent. The flow on the Sacramento River above Shasta Reservoir was the greatest ever recorded.

The outlook for 1959 irrigation water supplies is relatively good. On the favorable side of the picture is above normal reservoir storage on major streams. On some watersheds, this is substantial with next year's water requirements already on hand. On the deficit side, there is a large area of the Columbia, Colorado, and Great Basin watersheds where soils are extremely dry. Heavy fall rains or above normal winter snowpack will be required to produce average runoff for the 1959 snowmelt season. Where reservoir storage is not available, next year's water supplies will be directly related to mountain snowpack and soil moisture, and rainfall during the next growing season.

This report on water supply conditions is presented in RECLAMATION ERA through the courtesy of the authors under the direction of *R. A. Work*, Head, Water Supply Forecast Section, Soil Conservation Service.[1]

(Continued on page 109)

[1] THE SOIL CONSERVATION SERVICE coordinates snow surveys conducted by its staff and many cooperators, including the Bureau of Reclamation, Forest Service, Geological Survey, other Federal bureaus, various departments of the several States, irrigation districts, power companies, and others. The California State Department of Water Resources, which conducts snow surveys in that State, contributed the California figures appearing in this article.

WATER STORED IN WESTERN RESERVOIRS

(Operated by Bureau of Reclamation or Water Users except as noted)

Location	Project	Reservoir	Active storage (in acre-feet)		
			Active capacity	Aug. 31, 1957	Aug. 31, 1958
Region 1	Baker	Thief Valley	17,400	(1)	6,400
	Bitter Root	Lake Como	34,800	6,700	6,500
	Boise	Anderson Ranch	423,200	312,900	313,300
		Arrowrock	286,600	22,700	21,500
		Cascade	654,100	458,500	466,000
		Deadwood	161,900	121,800	107,600
		Lake Lowell	169,000	18,800	67,600
		Lucky Peak	278,200	242,800	261,400
	Burnt River	Unity	25,200	5,000	10,600
	Columbia Basin	F. D. Roosevelt Lake	5,072,000	4,914,000	5,225,000
		Banks Lake	761,800	649,600	759,100
		Potholes	470,000	146,200	102,100
	Deschutes	Crane Prairie	55,300	(1)	31,000
		Wickiup	187,300	69,000	89,000
	Hungry Horse	Hungry Horse	2,982,000	(1)	2,978,800
	Minidoka	American Falls	1,700,000	553,500	404,500
		Grassy Lake	15,200	11,900	9,200
		Island Park	127,200	65,400	39,500
		Jackson Lake	847,000	663,400	635,700
		Lake Walcott	95,200	95,400	90,900
	Ochoco	Ochoco	47,500	20,500	(1)
	Okanogan	Conconully	13,000	6,300	6,700
		Salmon Lake	10,500	(1)	10,300
	Owyhee	Owyhee	715,000	484,500	505,200
	Palisades	Palisades	1,202,000	548,600	548,600
	Umatilla	Cold Springs	50,000	6,400	6,500
		McKay	73,800	15,000	14,900
	Vale	Agency Valley	60,000	15,200	22,800
		Warm Springs	191,000	97,300	118,000
	Yakima	Bumping Lake	33,700	14,800	13,400
		Clear Creek	5,300	5,300	5,300
		Cle Elum	436,900	153,200	128,900
		Kachess	239,000	131,900	139,000
		Keechelus	157,800	35,400	35,600
		Tieton	198,000	71,900	62,100
Region 2	Cachuma	Cachuma	201,800	34,200	196,000
	Central Valley	Folsom [2]	920,300	580,900	621,500
		Jenkinson Lake	40,600	(1)	34,200
		Keswick	20,000	19,300	18,000
		Lake Natoma	8,800	8,100	8,700
		Millerton Lake	427,800	153,300	145,300
		Shasta Lake	3,998,000	3,167,200	3,282,600
		Lake Thomas A. Edison	125,100	(1)	119,200
	Klamath	Clear Lake	513,300	299,100	338,500
		Gerber	94,300	52,300	54,900
		Upper Klamath Lake	524,800	268,100	394,100
	Orland	East Park	50,600	15,500	35,000
		Stony Gorge	50,000	21,700	20,100

WATER STORED IN WESTERN RESERVOIRS—Continued

(Operated by Bureau of Reclamation or Water Users except as noted)

Location	Project	Reservoir	Active storage (in acre-feet)		
			Active capacity	Aug. 31, 1957	Aug. 31, 1958
Region 3	Boulder Canyon	Lake Mead	27, 207, 000	21, 498, 000	23, 814, 000
	Parker-Davis	Havasu Lake	216, 500	634, 600	573, 400
		Lake Mohave	1, 809, 800	1, 387, 400	1, 511, 700
	Salt River	Apache Lake	245, 100	216, 000	243, 000
		Bartlett	179, 500	66, 000	54, 000
		Canyon Lake	57, 900	46, 000	53, 000
		Horseshoe	142, 800	7, 000	20, 000
		Roosevelt	1, 381, 600	30, 000	396, 000
		Sahuaro Lake	69, 800	55, 000	56, 000
Region 4	Eden	Big Sandy	38, 300	30, 600	3, 500
	Fruitgrowers Dam	Fruitgrowers	4, 500	2, 100	1, 300
	Humboldt	Rye Patch	190, 000	62, 900	131, 100
	Hyrum	Hyrum	15, 300	5, 500	4, 700
	Mancos	Jackson Gulch	9, 800	9, 400	4, 700
	Moon Lake	Midview	5, 800	4, 400	600
		Moon Lake	35, 800	21, 000	7, 200
	Newlands	Lahontan	290, 900	159, 400	202, 500
		Lake Tahoe	732, 000	632, 400	698, 400
	Newton	Newton	5, 400	600	900
	Ogden River	Pineview	110, 200	28, 200	21, 300
	Pine River	Vallecito	126, 300	107, 900	62, 400
	Provo River	Deer Creek	149, 700	118, 100	101, 900
	Scofield	Scofield	65, 800	41, 700	39, 700
	Strawberry Valley	Strawberry Valley	270, 000	156, 000	155, 300
	Truckee Storage	Boca	40, 900	4, 600	11, 700
	Uncompahgre	Taylor Park	106, 200	108, 000	75, 200
	Weber River	Echo	73, 900	29, 300	8, 200
Region 5	W. C. Austin	Altus	162, 000	104, 000	107, 500
	Balmorhea	Lower Parks	6, 500	1, 900	2, 000
	Carlsbad	Alamogordo	122, 100	60, 600	123, 400
		Avalon	6, 000	(1)	4, 700
		McMillan	32, 300	(1)	35, 800
	Colorado River	Marshall Ford	1, 837, 100	703, 500	608, 000
	Middle Rio Grande	El Vado	194, 500	55, 500	128, 100
	Rio Grande	Caballo	340, 900	22, 300	50, 400
		Elephant Butte	2, 185, 400	516, 500	975, 900
	San Luis Valley	Platoro	60, 000	49, 500	34, 000
	Tucumcari	Conchas [2]	467, 300	75, 800	274, 000
	Vermejo	Reservoir No. 2	2, 900	1, 800	2, 200
		Reservoir No. 13	5, 000	1, 000	4, 700
		Stubblefield	16, 100	5, 500	12, 000
Region 6	Missouri River	Angostura	92, 000	69, 400	73, 700
		Boysen	710, 000	543, 000	475, 600
		Canyon Ferry	1, 615, 000	1, 375, 800	1, 387, 000
		Dickinson	13, 500	5, 000	4, 500
		Fort Randall [2]	4, 900, 000	1, 830, 400	1, 534, 000
		Garrison [2]	18, 100, 000	4, 728, 800	4, 786, 000
		Lake Taschida	218, 700	65, 700	63, 500
		Jamestown	39, 200	3, 900	14, 400
		Keyhole	190, 300	1, 700	0
		Lewis and Clark Lake [2]	385, 000	290, 500	332, 100
		Pactola	55, 000	12, 300	18, 300
		Shadehill	300, 000	82, 500	79, 100
		Tiber	762, 000	170, 200	196, 800
	Belle Fourche	Belle Fourche	185, 200	37, 600	34, 000
	Fort Peck	Fort Peck [2]	14, 839, 000	2, 840, 200	4, 655, 100
	Milk River	Fresno	127, 200	65, 700	43, 000
		Nelson	66, 800	49, 800	41, 000
		Sherburne Lake	66, 100	17, 200	16, 000
	Rapid Valley	Deerfield	15, 100	10, 200	9, 700
	Riverton	Bull Lake	152, 000	137, 100	97, 700
		Pilot Butte	31, 600	11, 000	6, 900
	Shoshone	Buffalo Bill	380, 300	322, 300	152, 400
	Sun River	Gibson	105, 000	31, 400	40, 000
		Pishkun	30, 100	7, 700	25, 500
		Willow Creek	32, 400	18, 200	29, 500
Region 7	Colo.-Big Thompson	Carter Lake	108, 900	77, 400	25, 400
		Granby	465, 600	395, 300	432, 800
		Green Mountain	146, 900	146, 300	137, 300
		Horsetooth	141, 800	94, 200	46, 700
		Shadow Mountain	1, 800	1, 300	600
		Willow Creek	9, 100	1, 300	4, 000
	Missouri River Basin	Bonny	167, 200	40, 300	34, 700
		Cedar Bluff	363, 200	198, 100	178, 500
		Enders	66, 000	30, 500	35, 000
		Harlan County [2]	752, 800	247, 800	236, 200
		Harry Strunk Lake	85, 600	34, 100	30, 000
		Kirwin	304, 800	80, 300	80, 600
		Swanson Lake	249, 800	111, 700	121, 600
		Webster	257, 400	70, 200	84, 100
	Kendrick	Alcova	24, 500	27, 500	27, 900
		Seminoe	957, 000	[3] 977, 400	928, 300
	Mirage Flats	Box Butte	30, 400	13, 200	16, 800
	North Platte	Guernsey	39, 800	26, 800	27, 000
		Lake Alice	11, 200	3, 400	1, 900
		Lake Minatare	59, 200	31, 200	29, 800
		Pathfinder	1, 010, 900	224, 300	900
Alaska Dist	Eklutna	Eklutna Lake	160, 000	160, 000	165, 900

[1] Not reported. [2] Corps of Engineers Reservoir. [3] Includes some superstorage above active capacity.

HANDICAPPED

(Continued from page 95)

Melvin L. Mediger

Huron, South Dakota, where he is presently employed as Acting Chief, Resources and Development Branch, Power Division.

Mr. Simmons is married and has three children, ranging in ages from 6 months to 5 years. He owns his own home and leads a full life in keeping up with his hobbies of amateur radio and gardening.

GILBERT S. ANDERSON of the Salt River Project in Phoenix, Arizona, suffers from arthritis believed induced by a back injury sustained in a fall from a platform in North Dakota.

He was born and reared in Donnybrook, North Dakota, and after completing his education at Donnybrook high school assisted his mother on their grain and cattle farm. He spent six months with the old Civilian Conservation Corps, working at the International Peace Gardens near the Canadian Border.

Anderson, customer service clerk in the Project's Power Billing department, blames all of his back trouble on the North Dakota fall and a cold train ride across the Rockies to California. He spent several years in various types of work before his doctor advised him to come to Phoenix.

A talented trumpet player, Anderson has operated his own dance orchestra and has played in a number of others. He still spends some of his free time on the band stand to supplement the family larder and he is affiliated with the Phoenix Musicians' local.

Irvin I. Simmons

Gilbert S. Anderson

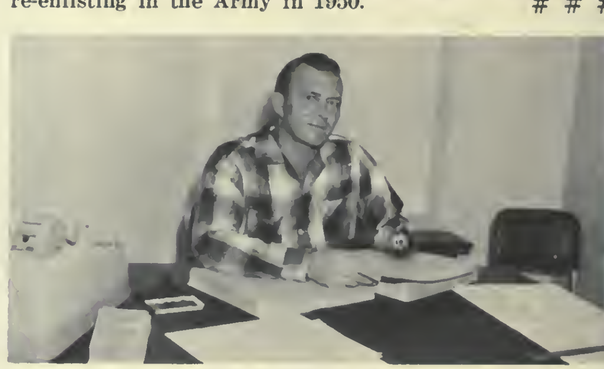
In order to enable him to perform his duties in the power business more efficiently, Anderson has taken courses in refrigeration and electricity. He is also an amateur carpenter and has built an addition to his house.

KEITH L. MASON, a native of Gypsum, Kansas, lost his left arm in an automobile accident near Williams Air Force Base while serving a second hitch with the Air Force. Mason's handicap has not prevented him from participating in sports despite the fact that he was a natural left hander. He developed a good right hand curve on the bowling alleys and is now president of the Thursday Night Bowling League at Chandler, Arizona.

He is now a general clerk in the Salt River Project Irrigation Service department and is currently assisting in setting up transfer journals. His fellow workers are the first to admit that Mason is a good, conscientious worker and asks no quarter because of his handicap.

During his first hitch with the Air Force, Mason graduated from Officers' Candidate School with a second lieutenant's commission. He spent some time in England during World War II with a Quartermaster Truck Company handling supplies and bombs.

Separated from the service in 1945 as a first lieutenant, he spent four years as a salesman in Spokane, Washington, re-enlisting in the Army in 1950. # # #



Keith L. Mason

PRESIDENT EISENHOWER in the conclusion of his proclamation stated in part "I particularly urge all employers to give the physically handicapped equal consideration for retention in their jobs as well as for employment, and I request our citizens to remember, throughout the year, that by their interest and assistance many handicapped persons can achieve economic independence and active participation in the total life of the national community."

(Continued from page 106)

In the following paragraphs, water conditions by States are briefly reviewed along with a statement of conditions affecting the 1959 water supply as of October 1.

ARIZONA. 1958 has been the best water year in Arizona since 1952. The carryover storage in the reservoirs assures the main agricultural areas of adequate water for the coming year. Storage in the eight major reservoirs in the State, excluding those on the Colorado River, is 121 percent of average and 28 percent of capacity. Soil moisture conditions in the mountain forest lands are good to excellent due to late summer rains.

CALIFORNIA. The California Department of Water Resources reports that water conditions during the spring and summer months were satisfactory throughout the State.

Winter precipitation was about 150 percent of average in most portions of the State. Storms during the first week in April brought large increases in snowpack in mountainous areas, further increasing runoff prospects for an already above-average year. Runoff in the North Coastal Area and Sacramento River above Shasta Dam exceeded that for any year since accurate records began on these streams. The unimpaired April–July runoff of major Central Valley streams was 22,800,000 acre-feet, as compared with an average runoff of 13,700,000 acre-feet.

All major reservoirs serving the Central Valley, with the exception of Isabella on the Kern River and Monticello on Putah Creek, were filled during the runoff period. As of October 1, 1958, there were 8,800,000 acre-feet of water stored in 43 major reservoirs serving the Central Valley. This was about 120 percent of the 10-year average, 65 percent of the usable capacity, and about 1,800,000 acre-feet more than the water in storage on October 1, 1957.

COLORADO. Irrigation water supplies were generally adequate for all areas of Colorado this year. Streamflow was near average. Reservoir storage carried over from 1957 and stored during the peak of snowmelt provided a good supply for late season irrigation. East of the mountains a lot of water was lost that normally would have been used or stored during May and early June. There was little demand and storage reservoirs were full. Rainfall was near normal in midsummer, but deficient in August and September. During this latter period there was a heavy demand on storage reserves which fortunately were available.

On the Colorado River early streamflow was high, particularly in southwestern Colorado. However, rainfall from May through August was near the lowest of record. Late streamflow was extremely deficient. Water shortages occurred where adequate storage was not available. Because of the drouth, total seasonal streamflow was 10 to 20 percent less than expected.

Mountain soils are relatively dry. Reservoir storage varies, being more than normal but less than for the fall of 1957. The outlook is much better than during the drouth period of 3 to 7 years ago, but normal or better mountain snowfall will be required to meet demands for irrigation next year. Large storage reservoirs of the city of Denver are still near capacity.

IDAHO. Late spring precipitation was responsible for giving Idaho a normal water supply this year. Streamflow was slightly greater than expected in early spring.

Reservoir storage at the end of the 1958 irrigation season is near that of a year ago in the older reservoirs. The new larger reservoirs, such as Lucky Peak and Palisades, contain slightly more water than on October 1, 1957, reflecting a greater proportion of storage in the new reservoirs. Carryover storage for 1959 is considered good.

Soil moisture conditions on all watersheds in Idaho are poor. A dry late summer and fall has depleted soil moisture far more than usual for this time of year.

Heavy rains during the fall will be necessary to ensure a normal runoff for 1959 from an average snowpack.

KANSAS. The irrigated area along the Arkansas River in western Kansas received more than an average water supply this year. Crops were good. Storage in John Martin and other reservoirs in eastern Colorado indicate a favorable outlook for 1959.

MONTANA. Water supplies for irrigation during the 1958 growing season were adequate. Forewarning of possible shortages in isolated areas required good water management. Although May rains were practically nonexistent, crops on dryland were saved by good rains in June, July and August. Storms were well spaced. Upland hay and grain production were in the bumper crop category for 1958. Irrigation reservoirs are slightly below average with above average storage in larger power reservoirs.

Carryover storage is satisfactory. Streamflow has been close to average in the Columbia Basin and about 75 percent of average in the Missouri Basin. Plains streams runoff was far below average during this season.

NEBRASKA. Surface soil moisture conditions are slightly below normal for most of the State. However, subsoil moisture is a little above normal. Storage in Nebraska is excellent, with most of the reservoirs close to the top of the irrigation pool. In percent, reservoir storage is better than 200 percent of normal and around 95 percent of usuable irrigation capacity. With the large reservoirs on the North Platte in Wyoming holding 125 percent of the normal carryover, the 1959 water outlook for Nebraska is excellent.

NEW MEXICO. For the first time in several years irrigation water supply in all areas served directly from streams in New Mexico has been adequate. Streamflow has been normal or above throughout the season. April and May flow of the Rio Grande was very high, but damage was averted through skillful use of available storage capacity. Storage measured in all major irrigation reservoirs in New Mexico is above normal. Alamogordo and Conchas in eastern New Mexico are near capacity.

Soil moisture in the mountains is not as favorable as in the fall of 1957, but is better than average. With a normal snowfall next winter, water supply for the 1959 season will be at least average.

NEVADA. Farmers and ranchers have just completed one of the best agricultural seasons in recent years. All water users had adequate supplies. A cool, dry spring allowed the heavy snowpack to decrease with minimum flood damage.

All major reservoirs, except Rye Patch on the Humboldt River, filled to capacity during the spring runoff. Lovelock Valley, served by Rye Patch, also had adequate water supplies. Even nonreservoir users experienced good late season water.

On October 1, Nevada reservoir storage was 72 percent of capacity or 130 percent of the average October 1 storage. This excellent carryover storage will provide a good start on next year's water needs.

OKLAHOMA. Water supply conditions were good for the W. C. Austin Project in Oklahoma for 1958. Streamflow was below normal, but so was irrigation water demand. There was a net increase in storage during the irrigation season. Outlook for next year is better than average for this early date.

OREGON. Irrigation water supplies in Oregon were adequate or better in the 1958 season. Only in a very few small scattered areas were "shortages" experienced and these represented areas where the lack of summer precipitation allowed streamflow to "fall off" earlier than had been expected.

Actual water supplies were similar to the outlook as forecast in the spring. The South Fork of the Walla Walla River near Milton produced within 4 percent of the forecast. Inflow to Upper Klamath Lake was 20 percent greater than forecast. Inflow to Owyhee Reser-

voir was 19 percent less than forecast. No other comparisons are available at this time.

Carryover storage is excellent with 25 reservoirs now holding 133 percent of the 1938–52 average. Mountain watersheds are very dry throughout the State, and fall rains have been absent or only very light thus far.

SOUTH DAKOTA. Reservoir storage in western South Dakota is 86 percent of normal as of October 1. Surface soils are relatively dry, but subsoil moisture is well above normal due to heavy rains in June and July. The outlook for next year, based on present conditions, is considered fair.

TEXAS. In contrast to recent years, water supplies along the Rio Grande in West Texas have been greater than average. Crop conditions are good and no reductions had to be made for prospective or actual water storage. A substantial part of next year's supply is stored in Elephant Butte Reservoir in New Mexico. On the Pecos River, water supplies were about average. Carryover in Red Bluff reservoir is near normal.

UTAH. Irrigation water supplies have been good throughout most of the State this summer. As was anticipated last May (when the final water supply forecast was issued) the only area where noticeable shortage occurred was in the eastern part of the Uinta Basin. Here, water users having natural flow rights had a short, late season supply, while those having reservoir storage rights had adequate water.

One of the driest summers of record caused streamflow to drop much faster than normally. Fortunately, the heavy high elevation snowpack kept streamflow up sufficiently so few natural flow rights were adversely affected.

The dry, hot summer has left the soil moisture in both the mountains and the valleys severely depleted. This means that unless heavy rains occur this fall before the winter snow begins to collect, an above average snowpack will be needed if streamflow next summer is to be adequate. This is particularly true for those who are dependent on the natural flow of the streams and those who are served by the smaller reservoirs.

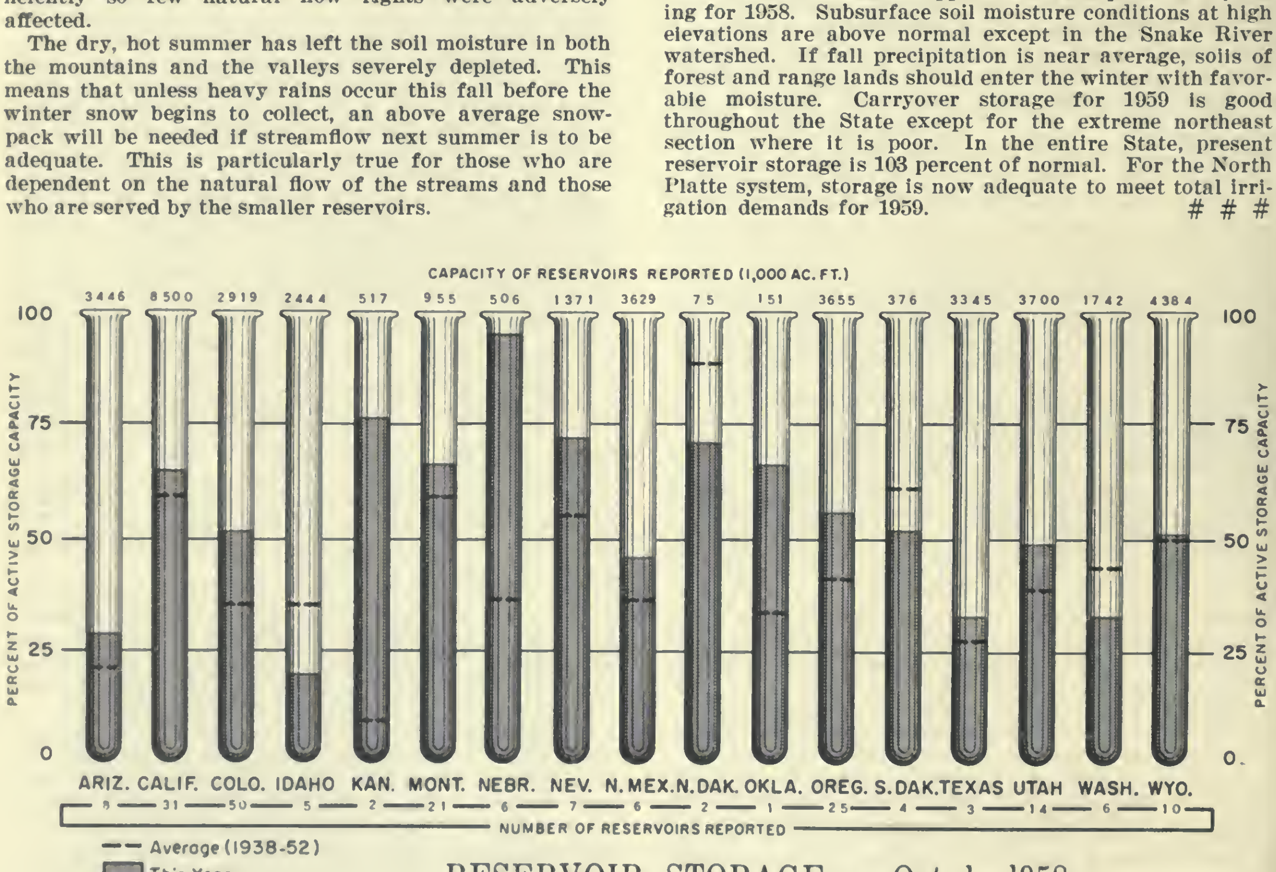
The combined storage in 14 reported reservoirs is 49 percent of capacity as compared to the average of 38 percent capacity. It is noted that relatively more water is stored in the larger reservoirs, since storage in some of the smaller reservoirs is as much as 20 percent below average.

WASHINGTON. The water supply for irrigation in the State of Washington has been adequate over most of the State. In the Columbia Basin and Yakima and Okanogan Rivers, water users who had storage rights had sufficient water, but those who relied on natural flow for their water supply were forced to curtail their normal irrigation operations.

Precipitation during the spring and summer was very erratic. A few stations reported above normal rainfall during a generally dry season. The forests have been tinder dry this summer with practically no rainfall at the high elevations. The drouth was partially relieved by rains in September. Rainfall in the Yakima Valley, as recorded at the reservoirs, was 91 percent of normal during the season. However, September rainfall averaged 172 percent of normal. The Okanogan Irrigation District reported that at Conconully only two of the six months during the irrigation season had below normal rainfall. The soil moisture condition of the watersheds as of October 1 is poor, which will adversely affect to some extent the water supply outlook for next year.

Reservoir storage is slightly less than normal and less than a year ago. If precipitation and snowfall are average this winter, the 1959 water supply should be reasonably adequate.

WYOMING. Water supplies were adequate in Wyoming for 1958. Subsurface soil moisture conditions at high elevations are above normal except in the Snake River watershed. If fall precipitation is near average, soils of forest and range lands should enter the winter with favorable moisture. Carryover storage for 1959 is good throughout the State except for the extreme northeast section where it is poor. In the entire State, present reservoir storage is 103 percent of normal. For the North Platte system, storage is now adequate to meet total irrigation demands for 1959. # # #



RESERVOIR STORAGE on Oct. 1, 1958

BUREAU WATER PLAYGROUNDS POPULAR

Bureau of Reclamation water playgrounds at Lake Mead, Coulee Dam, and Shadow Mountain, Colorado, were hosts to 11 percent of the 38,396,000 visitors during 1957 to 32 historic and recreation areas administered by the National Park Service. The National Park Service year-end report shows 4,318,713 visitors at the Reclamation areas, an increase of 317,325 over the previous year.

Lake Mead National Recreation Area at Hoover Dam ranked second in the Nation with 2,955,257 visitors; the Blue Ridge Parkway, Virginia, and North Carolina was first with 5,048,236.

The attendance record of the three Reclamation areas:

	1957	*1956*
Lake Mead	2, 955, 257	2, 672, 774
Shadow Mountain, Colo	1, 110, 824	1, 075, 982
Coulee Dam National Recreational Area	266, 863	252, 632

Lake Mead's visitors exceeded by 51,525 the 2,943,732 travelers to the most popular of the 29 National Parks, the Great Smoky Mountains, N. C.-Tenn.

WATER

WHAT IS WATER WORTH?

Water is a commodity so precious that no tyrant has ever dared deny it to his people. The earliest records of our civilization are linked to the spring and the waterhole, the river, and the well. The Children of Israel faltered in the wasteland and were ready to revolt until Moses struck the rock and brought forth a spring.

Wars have been fought over water rights and once mighty nations have vanished because their water resources failed. Men have battled to the death over the last few drops in a canteen. Formidable fortresses, impregnable in other respects, have fallen because of an insufficient water supply.

Ships' masters have had to risk the destruction of their vessels and the slaughter of their crews because water shortages forced landings on savage isles. Families have given up their homes and deserted their properties because of failing wells and dried-up water courses. London was virtually destroyed by fire in the seventeenth century and Chicago reduced to ashes in 1871 because sufficient water could not be delivered to the right place at the right time.

What is water worth?

Water is beyond price—so far beyond price that water is free of all price.

Reprinted from What Price Water? by permission of American Water Works Assoc., Inc., New York 16, New York.

NEW CROPPING METHODS

(Continued from page 92)

Irrigating potatoes on the Palisades Project in Idaho.
Photo by Phil Merritt, Region 1.

to the whole southern Idaho area, alfalfa hay running from 4 to 5 tons per acre and, in the lower elevations, 28 to 32 bushels of commercial beans.

Along with the lessons of early development, the Idaho farmer is also profiting by the knowledge that as the farm becomes an established unit, then proper rotation programs must be followed to retain the land's fertility and to maintain the full production potential. Thus it is that livestock feeding soon becomes a part of the farm program, along with the crop rotation designed to produce feed crops and cash crops.

It is indeed a wonderful sight to see the sagebrush giving way to beautiful new productive farmlands in southern Idaho and to observe each year at harvest time the bounteous yields of the soil which had lain unused and scorned as a desert for many, many years. The key to unlocking this new treasureland has been water, combined with man's ability and determination to find and make for himself and his family a home where each can contribute to earning the family living and where each may be a part of the dignity and strength of producing the food and fiber for our national requirements. # # #

GET "ACQUAINTED" COPIES

If you have friends or associates, who would be interested in the Reclamation Era, please send their names and addresses to the Bureau of Reclamation, Washington 25, D. C. We shall be glad to send them copies of back issues.

MAJOR RECENT CONTRACT AWARDS

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DC-5042	Little Wood River, Idaho.	Aug. 22	Enlargement of Little Wood River Dam	Lewis Hopkins Co. and Arthur R. Sime, Pasco, Wash.	$1,093,945
DC-5051	Missouri River Basin, N. Dak.	July 29	Construction of Stage 03 and 04 additions to Fargo substation.	William Collins & Sons, Inc., and Northolt Electric Co., Fargo, N. Dak.	236,343
DS-5052	Colorado River Storage, Ariz.-Utah.	July 1	Penstocks and outlet pipes for Glen Canyon Dam	Vinnell Steel, Irwindale, Calif.	3,778,000
DC-5058	Middle Rio Grande, N. Mex.	July 16	Construction of earthwork, clearing, and structures for irrigation rehabilitation, Belen Unit 9.	Shufflebarger & Associates, Inc., Albuquerque, N. Mex.	149,189
DC-5060	do	July 16	Construction of earthwork, clearing, and structures for irrigation rehabilitation, Belen Unit 11.	do	145,581
DC-5064	Rogue River Basin, Oreg.	Aug. 22	Construction of earthwork and structures for South Fork collection canal, Sta. 291+10.3 to 450+28.1; and Deadwood Creek siphon for Daley Creek collection canal.	Floyd R. Grubb, Salem, Oreg.	236,694
DC-5067	Ventura River, Calif.	Aug. 25	Construction of Casitas Nos. 1 and 2, Matilija No. 2, and Rincon chlorination stations.	Young & Anderson Co., Brea, Calif.	215,435
DC-5068	Columbia Basin, Wash.	Aug. 28	Construction of earthwork and structures for Potholes East canal enlargement, Sta. 172+00 to 251+00 and 510+00 to 770+00.	George W. Lewis and Thompson Construction Co., Kennewick, Wash.	693,119
DC-5069	Colorado River Storage, Utah-Wyo.	Aug. 19	Construction of administration building, garage and fire station, and field laboratory for Flaming Gorge community facilities.	Witt Construction Co., Provo, Utah.	161,052
DC-5076	Missouri River Basin, Mont.	Sept. 10	Construction of earthwork and structures for completion of Spokane Bench laterals.	Contractors and Excavators, Inc., and Zuber Brothers Contractors, Warden, Wash.	185,910
DC-5078	Missouri River Basin, N. Dak.	Sept. 8	Relocation of 1.9 miles of Devils Lake-Carrington 115-kv. transmission line.	Main Electric, Inc., Minot, N. Dak.	126,189
DC-5079	Weber Basin, Utah	Sept. 19	Construction of 8 reservoirs and Bountiful Subdistrict laterals, Davis aqueduct lateral system.	Nelson Brothers Construction Co., Salt Lake City, Utah.	446,073
DC-5080	Central Valley, Calif.	Sept. 4	Furnishing and installing armature winding for one of generator units 1, 2, or 3 at Shasta powerplant.	General Electric Co., Denver, Colo.	205,000
DC-5084	Rogue River Basin, Oreg.	Sept. 18	Construction of earthwork, concrete lining, and structures for Ashland lateral diversion dam and lateral extension, Schedules 1 and 3.	Cherf Brothers, Inc., Sandkay Contractors, Inc., and Cheney Construction Co., Ephrata, Wash.	305,851
DC-5085	Weber Basin, Utah	Sept. 5	Construction of earthwork, concrete canal lining, and structures for Gateway canal revision, Sta. 387+65 to 400+50 BK.	Mac Construction Co., Salt Lake City, Utah.	119,386
117C-514	Columbia Basin, Wash.	July 15	Constructing DE236 and DE236A drains and underdrain for Weber wasteway chute.	Lewis Construction Co., Inc., and S. L. Boutelle, Kennewick, Wash.	194,492

U. S. GOVERNMENT PRINTING OFFICE : 1958 O - 479605

Construction and Materials for Which Bids Will Be Requested Through December 1958*

Project	Description of work or material
Boulder Canyon, Ariz.-Nev.	One 115,000-hp, 180-rpm, 480-foot-head, vertical-shaft, Francis-type turbine with pressure regulator for Hoover powerplant, Unit N-8.
Do	One 168-inch butterfly valve for Hoover powerplant.
Do	One 100,000-kva, 16,500-volt, 3-phase, 180-rpm, vertical-shaft, hydraulic-driven generator for Hoover powerplant, Unit N-8.
Central Valley, Calif.	Constructing a 102-inch precast concrete pipe siphon under railroad and highway on the Corning canal.
Do	Constructing about 5 miles of bituminous-surface road from Stoney Creek to Ridgevill , and reinforced concrete bridge over Mule Creek.
Collbran, Colo	Earthwork and structures for about 22 miles of earth-lined and unlined canal and constructing 6 precast concrete pipe siphons.
Colorado River Storage, Ariz.	Constructing a 48- by 256-foot administration building and a combination garage, fire station, and police building.
Columbia Basin, Wash.	Constructing the indoor-type Radar pumping plant will include constructing a reinforced concrete substructure, a superstructure of structural steel frame with uninsulated metal panel siding, and a crane runway for a 15-ton traveling crane, installing 5 electrically driven, horizontal pumping units of 146-cfs total capacity.
Do	Constructing the Sand Hollow pumping plant will include an 81.5- by 27-foot building with concrete substructure and structural steel superstructure, installing 4 motor-driven pumping units, 3 with 51-cfs capacities and one with 25-cfs capacity with total heads of 65 feet, electrical control equipment.
Do	Relocating about 560 feet of the EL18 siphon and constructing structures. North of Moses Lake.
Do	Earthwork and structures for about 1 mile of 3-foot bottom width concrete-lined lateral and about 8 miles of unlined laterals with bottom widths varying from 6 to 2 feet, and one 36-inch precast concrete pipe siphon about 2,300 feet long.
Do	Earthwork and structures for about 18 miles of open-ditch drain and about 1 mile of closed pipe drain.
Do	Two motor-driven, horizontal, centrifugal-type pumping units each with a capacity of 20 cfs at a total head of 106 feet.
Do	Gravel surfacing about 50 miles of operating roads in Blocks 85 and 20, near Royal and Mesa.
Do	Furnishing and installing 8 automatic slide gates on the West canal, fifth section, northwest of Othello.
Fort Peck, Mont	Additions to the Dawson County substation will include grading and fencing a major extension to the area, constructing concrete foundations, furnishing and erecting steel structures, installing 3 single-phase, 230/115/13.2-kv, 20,000-kva autotransformers and associated electrical equipment, major items of which will be Government furnished. Near Glendive.
Milk River, Mont	Two 4- by 5-foot, high-pressure gate valves and hydraulic hoists for Sherburne Lake dam.
Minidoka, Idaho	Modifying laterals and constructing drains for the North Side Pumping Division, near Rupert.
MRB, Colorado	Reconductoring about 30 miles of 115-kv wood-pole transmission line from Flatiron switchyard, near Loveland, to Greeley substation.
MRB, Kansas	Earthwork and structures for about 14 miles of canal, and about 17 miles of laterals, including precast concrete pipe siphons, highway and railroad crossings, and 3 small pumping plants. Osborne canal and laterals, near Alton.
MRB, Montana	Earthwork and structures for about 45 miles of open ditch laterals and about 20 miles of open and closed drains. Helena Valley Unit, near Helena.
MRB, Nebraska	Earthwork and structures for about 15 miles of 18- and 20-foot bottom width Culbertson canal, near Culbertson.
MRB, North Dakota.	Furnishing and stringing 795,000 CM ACSR conductors and 0.5-inch steel overhead ground wires for the 165-mile, single-circuit, steel Fargo-Granite Falls 230-kv transmission line.
MRB, Wyoming	Constructing about 35 miles of 115-kv, wood-pole transmission line from Boysen switchyard to Pilot Butte switchyard.
Do	Completion of the Fremont Canyon powerplant and switchyard will include placing second stage concrete for a 2-unit powerplant, installing embedded and non-embedded parts for two 24,000-kw generators and two 33,500-hp turbines and other hydraulic, mechanical and electrical machinery.
Do	One 10,000-kva, 115- to 69-kv power transformer for Pilot Butte switchyard.
Provo River, Utah.	Constructing about 8,355 feet of riprap-faced dikes on the Provo River.
Riverton, Wyo	Furnishing and applying about 1,200 tons of catalytically-blown asphalt membrane lining to Wyoming and Pilot canals and laterals.
Washita Basin, Okla.	Clearing timber and brush, and clean-up work in the Fort Cobb reservoir area.
Do	Earthwork and structures for about 21 miles of 15-, 18-, 21-, 27-, 30-, and 33-inch precast reinforced concrete pipelines for the Anadarko aqueduct.
Weber Basin, Utah.	Constructing about 800 linear feet of 12-inch and 2,800 linear feet of 27-inch precast concrete pipeline, both of which are to be connected to the existing Davis aqueduct.
Yakima, Wash	Supplemental construction and lining portions of Kennewick Main canal, near Kennewick.

*Subject to change.

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